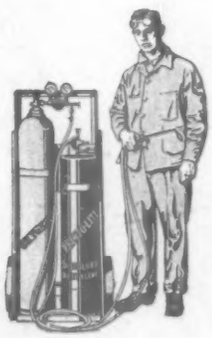
Of this issue more than 4000 copies were printed

The Welding Engineer

Vol. 1 | Chicago 608 S. Dearborn St. | OCTOBER, 1916 | $2.00 per year in U. S. $2.50 per year abroad | No. 10

Oxy-Acetylene Welding and Cutting

No matter what welding process you now use, you need this also



No matter what other welding methods are now employed in your shop or factory, the Prest-O-Lite Process will pay you additional dividends. It will handle certain work quicker, cheaper and better than other methods. In many cases the added strength, economy of labor and material so easily effected by the Prest-O-Lite Process are entirely outside the range of other welding processes.

The perfect portability of this outfit makes it far superior and more profitable than a stationary outfit—it is ready for instant use inside or outside the shop. In everyday repair work, the outfit will save its initial cost many times over, in a very short time.

You may be using other welding processes with profit but some place in your shop or factory there is also a real need for the Prest-O-Lite Process.

Our welding literature is full of helpful suggestions to manufacturers and engineers. Write for it.

The Prest-O-Lite Co., Inc.

The World's Largest Makers of Dissolved Acetylene

Main Office and Factory, 851 Speedway, Indianapolis, Ind.
Canadian Office and Factory, Merritton, Ont.

Prest-O-Lite PROCESS

*Alphabetical Index to Advertisers and Buyers' Index, Page 4.

The largest makers of Oxy-Acetylene Welding and Cutting Equipment and Supplies in the World

Oxweld Equipment includes Acetylene Generators, Welding and Cutting Blow Pipes, Regulators and Supplies—everything needed for all requirements—complete installations for the most extensive manufacturing and repair operations to portable units for emergency and field use. Because of the scientific accuracy and exactness of design—high quality materials and the mechanical perfection of construction and workmanship, **OXWELD EQUIPMENT** will produce the most efficient and economical results in welding and cutting operations of every character.

Oxweld Supplies are made up in accordance with the formulae of our metallurgists—tested by analysis in our laboratory and their merits tested out and proven by our expert welders in actual shop practice. We guarantee **OXWELD SUPPLIES,** when used by competent welders, to produce better results than any others known to the art today.

Our knowledge and experience, as the largest makers of welding and cutting equipment in the world, are always at the service of every purchaser and prospective purchaser of **OXWELD APPARATUS,** to determine the most economical and efficient applications of the **PROCESS** to the manufacturing or repair problems at hand.

Write us for information on any class of Welding or Cutting Work

Oxweld Acetylene Company

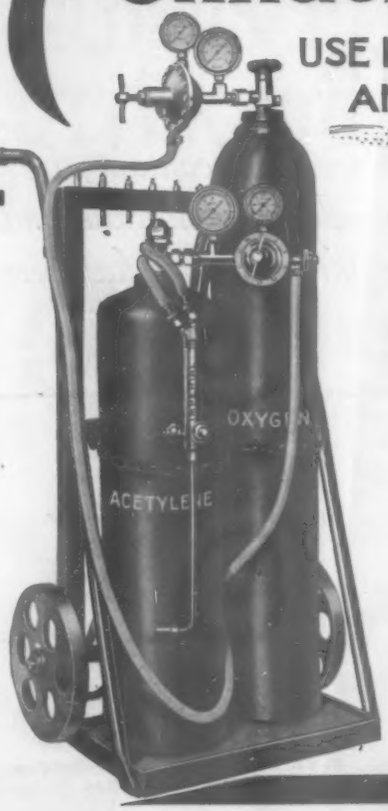
CHICAGO
36th St. and Jasper Place

NEWARK, N. J.
6460-680 Frelinghuysen Ave.

LOS ANGELES
654-656 Pacific Electric Bldg.

Confidence in the weld

USE IMPERIAL EQUIPMENT
AND BANK ON THE RESULT



Safety
Economy
Efficiency

All are attained to the highest degree with the IMPERIAL TORCH

By an exclusive mixing principle, we obtain a positively neutral flame, without which successful welding cannot be accomplished.

If you are looking for the torch which is most economical of gas, most practical in every way for field work, the answer is Imperial every time. The same holds true of its qualities as a cutting torch. It is rugged, faithful, speedy.

The way to get acquainted with it is to write for Catalog No. 135.

The Imperial Brass Mfg. Co.

522 South Racine Ave. CHICAGO

Extra Money For Salesmen

Experience has taught us that it is an easy matter to secure subscriptions to The Welding Engineer, when the attention of the right man is secured. They all need good, authentic information about welding.

Several hustling apparatus salesmen are increasing their earnings by soliciting subscriptions for The Welding Engineer. The men you call on are the very men who need the paper and want it. We pay you a liberal commission. At the close of your call it's an easy matter to make the price of your dinner.

Write me today and I'll tell you all about the plan.

L. B. MACKENZIE

The Welding Engineer

608 S. DEARBORN ST. CHICAGO

Cut Your Gas Costs in Half

We have convincing figures—derived not from laboratory tests, but from plants in every-day service—showing that an equipment of

I.O.C. SYSTEM OXYGEN AND HYDROGEN

GENERATORS

Brings the cost of gas down to one-half or one-third the figure ordinarily charged for gas purchased in cylinders. And the greater purity of I. O. C. gases means a further economy due to higher efficiency in application. Doesn't this suggest the worth-whileness of sending for the I. O. C. literature?

I. O. C. Single Unit Generator

Send for new Catalogue No. 3, describing the new I. O. C. High-efficiency Generators.

International Oxygen Company

General Sales Office: 115 Broadway, New York

London: Arthur Lyon & Wrench, Ltd., Caxton House, S. W.

Buyers' Index

Readers of The Welding Engineer will find this index to contain the most accurate information obtainable relating to welding apparatus and supplies. The advertising section includes the principal manufacturers of the United States.

ACETYLENE (Compressed in Cylinders)
Commercial Acetylene Welding Co.
The Prest-O-Lite Co., Inc.
Universal Oxygen Co.

ACETYLENE GENERATORS
Bermo Welding Apparatus Co.
Davis-Bournonville Co.
International Oxygen Co.
Oxweld Acetylene Co.
Superior Oxy-Acetylene Machine Co.

ALUMINUM FILLER RODS
American Oxygen Co.
Bermo Welding Apparatus Co.
Davis-Bournonville Co.
The Imperial Brass Mfg. Co.
Indiana Oxygen Co.
Oxweld Acetylene Co.
The Prest-O-Lite Co.
Superior Oxy-Acetylene Mach. Co.
United States Welding Co.
Universal Oxygen Co.
Welding Materials.

ALUMINUM FLUX
American Oxygen Co.
Bermo Welding Apparatus Co.
Davis-Bournonville Co.
The Imperial Brass Mfg. Co.
Indiana Oxygen Co.
Oxweld Acetylene Co.
The Prest-O-Lite Co.
Superior Oxy-Acetylene Machine Co.
United States Welding Co.
Universal Oxygen Co.
Welding Materials.

ALUMINUM SOLDER
National Solder Co.

ANNEALING FURNACES
Buffalo Dental Mfg. Co.
Universal Oxygen Co.

APRONS (Asbestos)
Welding Materials.

ASBESTOS GLOVES
Welding Materials.

ASBESTOS SHEET PAPER
American Oxygen Co.
Davis-Bournonville Co.
Indiana Oxygen Co.
Oxweld Acetylene Co.
Superior Oxy-Acetylene Machine Co.
United States Welding Co.
Universal Oxygen Co.
Welding Materials.

BLOW TORCHES (Acetylene)
American Oxygen Co.
Bermo Welding Apparatus Co.
Buffalo Dental Mfg. Co.
Indiana Oxygen Co.
The Alexander Milburn Co.
The Prest-O-Lite Co.

BOOKS (Relating to Welding)
The Welding Engineer

BRASS AND BRONZE FLUX
American Oxygen Co.
Bermo Welding Apparatus Co.
Davis-Bournonville Co.
The Imperial Brass Mfg. Co.
Indiana Oxygen Co.
United States Welding Co.
Oxweld Acetylene Co.
The Prest-O-Lite Co.
Superior Oxy-Acetylene Machine Co.
Universal Oxygen Co.
Welding Materials.

BRASS SPELTER WIRE
Universal Oxygen Co.

BRAZING OUTFITS
Buffalo Dental Mfg. Co.
Superior Oxy-Acetylene Machine Co.

BRONZE FILLER RODS
American Oxygen Co.
Bermo Welding Apparatus Co.
Davis-Bournonville Co.
The Imperial Brass Mfg. Co.
Indiana Oxygen Co.
Oxweld Acetylene Co.
Superior Oxy-Acetylene Machine Co.
United States Welding Co.
Universal Oxygen Co.
Welding Materials.

BUTT WELDERS (Electric Resistance)
Thomson Electric Welding Co.
Welding Materials.

CARBIDE (Calcium)
American Carbolite Sales Co.
Union Carbide Sales Co.
Canada Carbide Sales Co.

CARBON REMOVING TORCHES
American Oxygen Co.
The Bastin-Blessing Co.
Bermo Welding Apparatus Co.
The Bishop-Babcock-Becker Co.
Davis-Bournonville Co.
General Welding & Equipment Co.
Henderson-Willis Welding & Cutting Co.
The Imperial Brass Mfg. Co.
Indiana Oxygen Co.
The Alexander Milburn Co.
Metals Welding Co.
Oxweld Acetylene Co.
The Prest-O-Lite Co., Inc.
Superior Oxy-Acetylene Mach. Co.
Universal Oxygen Co.

CAST IRON FILLER RODS AND FLUX
American Oxygen Co.
Bermo Welding Apparatus Co.
Davis-Bournonville Co.
The Imperial Brass Mfg. Co.
Indiana Oxygen Co.
Oxweld Acetylene Co.
The Prest-O-Lite Co.
Superior Oxy-Acetylene Machine Co.
United States Welding Co.
Universal Oxygen Co.
Welding Materials.

ELECTRIC ARC WELDING OUTFITS
Westinghouse Electric & Mfg. Co.
Welding Materials.
General Electric Co.

ELECTROLYTIC OXYGEN PLANTS
International Oxygen Co.
Universal Oxygen Co.

FILLER RODS (Aluminum)
United States Welding Co.
The Prest-O-Lite Co.

FILLER RODS (Swedish Iron)
Apex Steel Corporation.
Bermo Welding Apparatus Co.
Davis-Bournonville Co.
The Imperial Brass Mfg. Co.
Oxweld Acetylene Co.
The Prest-O-Lite Co.
Superior Oxy-Acetylene Machine Co.
Universal Oxygen Co.
Welding Materials.

FILLER RODS (Tobin Bronze)
American Oxygen Co.
Bermo Welding Apparatus Co.
Davis-Bournonville Co.
The Imperial Brass Mfg. Co.
Indiana Oxygen Co.
Oxweld Acetylene Co.
The Prest-O-Lite Co.
Superior Oxy-Acetylene Machine Co.
United States Welding Co.
Universal Oxygen Co.
Welding Materials.

FILLER RODS (Vanadium Steel)
American Oxygen Co.
Bermo Welding Apparatus Co.
Davis-Bournonville Co.
The Imperial Brass Mfg. Co.
Indiana Oxygen Co.
Oxweld Acetylene Co.
The Prest-O-Lite Co.
Superior Oxy-Acetylene Machine Co.
United States Welding Co.
Universal Oxygen Co.
Welding Materials.

FIREPROOF PLASTIC
Bermo Welding Apparatus Co.

FLUE WELDERS (Electric Resistance)
Thomson Electric Welding Co.

FLUX WELDERS (Electric)
Westinghouse Electric & Mfg. Co.

FURNACES (Annealing)
Buffalo Dental Mfg. Co.
Universal Oxygen Co.

GASOLINE PREHEATING FURNACES
Buffalo Dental Mfg. Co.
The Prest-O-Lite Co., Inc.
Superior Oxy-Acetylene Machine Co.

GAS BURNERS (Preheating)
Superior Oxy-Acetylene Machine Co.
Universal Oxygen Co.
Westinghouse Electric & Mfg. Co.

GLOVES (Asbestos)
United States Welding Co.
Welding Materials.

GOGGLES AND HOODS (Welders)
American Oxygen Co.
William C. Adams.
Bermo Welding Apparatus Co.
Chicago Eye Shield Co.
Davis-Bournonville Co.
F. A. Hardy & Co.
The Imperial Brass Mfg. Co.
Indiana Oxygen Co.
Oxweld Acetylene Co.
The Prest-O-Lite Co.
Superior Oxy-Acetylene Machine Co.
United States Welding Co.
Universal Oxygen Co.
Westinghouse Electric & Mfg. Co.
Welding Materials.

GLOVES (Welders Asbestos)
American Oxygen Co.
Davis-Bournonville Co.
Indiana Oxygen Co.
Oxweld Acetylene Co.
Universal Oxygen Co.

GAUGES (Pressure)
American Oxygen Co.
The Bastin-Blessing Co.
Bermo Welding Apparatus Co.
The Bishop-Babcock-Becker Co.
Davis-Bournonville Co.
The Imperial Brass Mfg. Co.
Indiana Oxygen Co.
Oxweld Acetylene Co.
The Prest-O-Lite Co.
United States Welding Co.
Universal Oxygen Co.
U. S. Gauge Co.

HARDENING FURNACES
Buffalo Dental Mfg. Co.

WELDING OUTFITS
CUTTING OUTFITS

OXY-ACETYLENE WELDING
DAVIS
APPARATUS
DAVIS-BOURNONVILLE CO. N.Y.

Leads the world for range, efficiency and number of outfits in successful use

Davis apparatus offers the widest range of equipment made for employing to its greatest value the oxy-acetylene process of welding and cutting, backed by the longest service, the most extensive experience, and the greatest development in apparatus and in application.

It is employed by the most prominent concerns in the iron and steel and metal working industries, and was awarded the highest honors at the Panama-Pacific International Exposition —two Medals of Honor (higher award than the Gold Medal) and a Gold Medal.

Complete plants with acetylene and oxygen generating and compressing systems, and welding and cutting stations, for the largest industries, with portable outfits for field work and small plants for general repair shops. Complete information on request.

Davis-Bournonville Company

NEW YORK **CHICAGO**

General Offices and Factory: Jersey City, N. Y.

Sales Offices: New York, Chicago, Detroit, Cleveland, Pittsburgh, Philadelphia, Boston.

MILBURN APPARATUS

Milburn mixing principle produces best work with minimum gas, and no flash backs, burnt tips, or other annoyances.

Exceptionally durable construction of torches insures long, satisfactory service. Regulators dependable and free from valve, diaphragm and gauge troubles.

Ask for Catalogue No. 35.

The Alexander Milburn Company
Baltimore, Maryland

Oxweld Apparatus For Railroad Service

is to broken equipment what a new point is to your pencil. Its use gets the other 95% value out of your equipment that has broken long before its mechanical life should have gone.

Reclaim the profits discarded in your scrap pile with our Oxweld outfit. A broken tooth on a gear is easily built up and refinished and the gear goes back to work for its full life, and so on throughout the whole list.

On your wrecking trains this outfit will prove of untold value. Tangled steel wreckage is quickly cut up; service is quickly resumed. The cost is tremendously reduced. The profit is the difference between scrap value and replacement cost, less the small cost of repairs.

Oxweld Railroad Service Co.

Railway Exchange Building, Chicago **30 Church Street, New York**

HOSE (Oxygen and Acetylene)
American Oxygen Co.
Bermo Welding Apparatus Co.
Buffalo Dental Mfg. Co.
Davis-Bournonville Co.
Imperial Brass Mfg. Co.
K-G Welding & Cutting Co.
Oxweld Acetylene Co.
Superior Oxy-Acetylene Machine Co.
The Prest-O-Lite Co.
United States Welding Co.
Universal Oxygen Co.

HOSE UNIONS
Bermo Welding Apparatus Co.
K-G Welding & Cutting Co.
Superior Oxy-Acetylene Machine Co.

HYDROGEN
International Oxygen Co.
Universal Oxygen Co.

KEROSENE PREHEATING TORCHES
Goldschmidt Thermit Co.
The Imperial Brass Mfg. Co.
Oxweld Acetylene Co.
The Prest-O-Lite Co.
Superior Oxy-Acetylene Machine Co.

NEEDLE VALVES
The Bastin-Blessing Co.
Bermo Welding Apparatus Co.
Buffalo Dental Mfg. Co.
K-G Welding & Cutting Co.
Superior Oxy-Acetylene Machine Co.

OIL BURNERS (Preheating)
Oxweld Acetylene Co.
Superior Oxy-Acetylene Mach. Co.

OXYGEN (Compressed in Cylinders)
The Linde Air Products Co.
Swift & Co.
Universal Oxygen Co.

PIPE WELDING
Goldschmitt Thermit Co.

PHOTOGRAPHS
Chicago Architectural Photographing Co., (Specialists in photographs relating to the welding industry)

PLASTIC (Fireproof)
Welding materials.

PRESSURE GAUGES
The Bastin & Blessing Co.
Bermo Welding Apparatus Co.
The Bishop-Babcock-Becker Co.
Davis-Bournonville Co.
The Imperial Brass Mfg. Co.
International Oxygen Co.
Oxweld Acetylene Co.
The Prest-O-Lite Co.
Superior Oxy-Acetylene Machine Co.
U. S. Gauge Co.
United States Welding Co.
Universal Oxygen Co.

RAILROADS—Special Service for
Oxweld Railroad Service Co.

REGULATING VALVES (Acetylene)
The Bastin-Blessing Co.
Bermo Welding Apparatus Co.
The Bishop-Babcock-Becker Co.
Davis-Bournonville Co.
The Imperial Brass Mfg. Co.
International Oxygen Co.
K-G Welding & Cutting Co.
Oxweld Acetylene Co.
Superior Oxy-Acetylene Machine Co.
The Prest-O-Lite Co., Inc.
United States Welding Co.
Universal Oxygen Co.

REGULATING VALVES (Hydrogen)
The Bastin-Blessing Co.
Bermo Welding Apparatus Co.
The Bishop-Babcock-Becker Co.
The Prest-O-Lite Co.
The Imperial Brass Mfg. Co.
International Oxygen Co.
K-G Welding & Cutting Co.
Superior Oxy-Acetylene Machine Co.
Universal Oxygen Co.

REGULATING VALVES (Oxygen)
American Welding Co.
The Bastin-Blessing Co.
Bermo Welding Apparatus Co.
The Bishop-Babcock-Becker Co.
Davis-Bournonville Co.
The Imperial Brass Mfg. Co.
International Oxygen Co.
K-G Welding & Cutting Co.
Oxweld Acetylene Co.
Superior Oxy-Acetylene Machine Co.
United States Welding Co.
Universal Oxygen Co.

SEAM WELDERS (Electric)
General Electric Co.
Westinghouse Electric & Mfg. Co.

SEAM WELDERS (Electric Resistance)
Thomson Electric Welding Co.

SPOT WELDERS (Electric Resistance)
Thomson Electric Welding Co.

TANK CONNECTIONS (Oxygen and Acetylene Adaptors)
Superior Oxy-Acetylene Machine Co.

THERMALENE-GAS
The Thermalene Co.

THERMIT WELDING
Goldschmidt-Thermit Co.

TORCHES (Gasoline and Kerosene Preheating)
Buffalo Dental Mfg. Co.
General Welding & Eq. Co.
The Bishop-Babcock-Becker Co.
The Imperial Brass Mfg. Co.
Oxweld Acetylene Co.
The Prest-O-Lite Co.
Superior Oxy-Acetylene Machine Co.
United States Welding Co.
Westinghouse Electric & Mfg. Co.

TORCHES (Oxy-Acetylene Cutting)
Bermo Welding Apparatus Co.
The Bishop-Babcock-Becker Co.
Davis-Bournonville Co.
General Welding & Eq. Co.
Henderson-Willis Welding & Cutting Co.
The Imperial Brass Mfg. Co.
K-G Welding & Cutting Co.
The Alexander Milburn Co.
Oxweld Acetylene Co.
The Prest-O-Lite Co., Inc.
Superior Oxy-Acetylene Machine Co.
The Thermalene Co.
United States Welding Co.
Universal Oxygen Co.

TORCHES (Oxy-Acetylene Welding)
Bermo Welding Apparatus Co.
The Bishop-Babcock-Becker Co.
Davis-Bournonville Co.
General Welding & Eq. Co.
Henderson-Willis Welding & Cutting Co.
The Imperial Brass Mfg. Co.
K-G Welding & Cutting Co.
The Alexander Milburn Co.
Oxweld Acetylene Co.
The Prest-O-Lite Co., Inc.
Superior Oxy-Acetylene Machine Co.
The Thermalene Co.
United States Welding Co.
Universal Oxygen Co.

TORCHES (Oxy-Hydrogen Cutting)
Bermo Welding Apparatus Co.
The Bishop-Babcock-Becker Co.
Davis-Bournonville Co.
General Welding & Eq. Co.
Henderson-Willis Welding & Cutting Co.
The Alexander Milburn Co.
The Imperial Brass Mfg. Co.
Oxweld Acetylene Co.
Superior Oxy-Acetylene Machine Co.
Universal Oxygen Co.

TORCHES (Oxy-Hydrogen Welding)
Bermo Welding Apparatus Co.
The Bishop-Babcock-Becker Co.
Buffalo Dental Mfg. Co.
Davis-Bournonville Co.
General Welding & Eq. Co.
Henderson-Willis Welding & Cutting Co.
The Imperial Brass Mfg. Co.
The Alexander Milburn Co.
Oxweld Acetylene Co.
United States Welding Co.
Universal Oxygen Co.

TORCHES (Special to Order)
Bermo Welding Apparatus Co.
The Bishop-Babcock-Becker Co.
Superior Oxy-Acetylene Machine Co.

TRUCKS (Cylinder Carriers)
Davis-Burnonville Co.
The Imperial Brass Mfg. Co.
Oxweld Acetylene Co.
The Prest-O-Lite Co.
Superior Oxy-Acetylene Machine Co.
United States Welding Co.
Universal Oxygen Co.

VALVES (For Oxygen Cylinders)
The Bastin-Blessing Co.
International Oxygen Co.
Universal Oxygen Co.

WELDING (Electric Resistance-Custom Work)
Thomson Electric Welding Co.

WELDERS' GOGGLES
William C. Adams.
Bermo Welding Apparatus Co.
Davis-Bournonville Co.
The Imperial Brass Mfg. Co.
K-G Welding & Cutting Co.
Oxweld Acetylene Co.
The Prest-O-Lite Co.
Superior Oxy-Acetylene Machine Co.
United States Welding Co.
Universal Oxygen Co.
Welding Materials.

WELDING (Oxygen for)
International Oxygen Co.
The Linde Air Products Co.
Universal Oxygen Co.

WELDING TORCHES (Oxy-Acetylene)
Bermo Welding Apparatus Co.
The Bishop-Babcock-Becker Co.
Davis-Bournonville Co.
General Welding & Eq. Co.
The Imperial Brass Mfg. Co.
K-G Welding & Cutting Co.
Henderson-Willis Welding & Cutting Co.
The Alexander Milburn Co.
Oxweld Acetylene Co.
The Prest-O-Lite Co., Inc.
Superior Oxy-Acetylene Machine Co.
The Thermalene Co.
United States Welding Co.
Universal Oxygen Co.

WELDING TORCHES (Oxy-Hydrogen)
Bermo Welding Apparatus Co.
The Bishop-Babcock-Becker Co.
Buffalo Dental Mfg. Co.
Davis-Bournonville Co.
General Welding & Eq. Co.
Henderson-Willis Welding & Cutting Co.
The Alexander Milburn Co.
The Imperial Brass Mfg. Co.
Oxweld Acetylene Co.
Superior Oxy-Acetylene Machine Co.
United States Welding Co.
Universal Oxygen Co.

ALPHABETICAL INDEX TO ADVERTISERS

A
Apex Steel Corporation..... 9
Adams, William C..... 12
American Carborilite Sales Co..... 15
American Oxygen Co..... 10

B
The Bastin-Blessing Co..... 8
Bermo Welding Apparatus Co..... 13
The Bishop-Babcock-Becker Co..... 31
Buffalo Dental Mfg. Co..... 13

C
Canada Carbide Sales Co..... 9
Chicago Eye Shield Co..... 31
Commercial Acetylene Welding Co..... 37

D
Davis-Bournonville Co..... 5

G
General Welding & Equipment Co..... 32
General Electric Co..... 14
Goldschmidt Thermit Co.....Back cover

H
Henderson-Willis Welding & Cutting Co... 13
F. A. Hardy & Co..... 10

I
Imperial Brass Mfg. Co..... 3
International Oxygen Co..... 3
Indiana Oxygen Co..... 10
Indiana Oxygen Co..... 14

K
K-G Welding & Cutting Co., Inc..... 12

L
Linde Air Products Co..... 16

M
The Alexander Milburn Co..... 5
Metals Welding Co.....

N
National Solder Co..... 11

O
Oxweld Acetylene Co..... 2
Oxweld Railroad Service Co..... 5

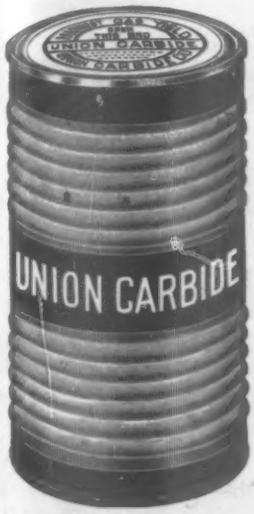
P
Prest-O-Lite Co., Inc.....Front cover

S
Superior Oxy-Acetylene Machine Co..... 31
Swift & Co..... 10

T
The Thermalene Co..... 8
Thomson Electric Welding Co..... 15

U
Union Carbide Sales Co..... 7
United States Welding Co..... 33
Universal Oxygen Co..... 13
U. S. Gauge Co..... 6

W
Westinghouse Electric & Mfg. Co..... 41



Packed in Blue and Gray Drums

Union Carbide Sales Company

New York City, 42nd St. Building — **Chicago, Ill., Peoples Gas Building** — **San Francisco, Cal., Kohl Building**

SOLE DISTRIBUTORS OF

UNION CARBIDE

"World's Best Quality—Highest Gas Yield"

For Oxy-Acetylene Welding Plants

Contractors' Flare Lights, Torches and Private and Municipal Lighting Plants

"Union Carbide" is packed in 100-lb. blue and gray drums marked conspicuously, "UNION CARBIDE."

The following sizes are carried in stock in 100-lb. drums:

$3\frac{1}{2}$ x 2 in. —a large size.

2 x $\frac{1}{2}$ in. —a medium size.

$1\frac{1}{4}$ x $\frac{3}{8}$ in. —an intermediate size.

$\frac{1}{4}$ x 1/12 in. —finely crushed size.

Union Carbide in the Generator sizes above listed will be shipped direct to consumers from a **Union Carbide Sales Co.** warehouse at any one of the following points where large stocks are kept on hand:

ALABAMA
Birmingham—1916 Morris Ave.
Mobile—262-268 S. Water St.
Montgomery—114 N. Perry St.
ARIZONA
Phoenix—16 S. Central Ave.
ARKANSAS
Fort Smith—109-123 So. Ninth St.
CALIFORNIA
Eureka—109 Second St.
Fresno—932 H St.
Los Angeles—639 Gibbon St.
Sacramento—1523-31 Front St.
San Diego—326-336 Fifth St.
San Francisco—Kohl Building.
COLORADO
Denver—Nineteenth and Wazee Sts.
Victor—Third and Diamond Sts.
CONNECTICUT
Hartford—877 Main St.
DISTRICT OF COLUMBIA
Washington—Maryland Ave. and 9th St., S. W.
FLORIDA
Jacksonville—106 E. Forsyth St.
Tampa—413 Tampa St.
GEORGIA
Atlanta—Cor. Haynes and Rhodes Sts., P. O. Box 1594.
Savannah—Ogeechee Canal, South of Bay St., P. O. Box 78.
ILLINOIS
Chicago—Peoples Gas Bldg., Michigan Blvd.
Decatur—133-147 W. Williams St.
East St. Louis—600 Walnut Ave.
Peoria—721-731 So. Washington St.
Marion—315 S. Granite St., Box 747.
Monmouth—401 S. First St.
Quincy—222 S. Eighth St.
Streator—702 East Elm St.
INDIANA
Evansville—1601 Illinois St.
Indianapolis—110-112 S. Alabama St.
Terre Haute—931 Wabash Ave.
IOWA
Des Moines—117-119 Fifth St.
Dubuque—8th and Washington Sts.
Ottumwa—207-9-11 S. Washington St.
Sioux City—825 Fourth St., P. O. Box 398.
KANSAS
Pittsburg—109 W. Third St.
Salina—103 S. Fifth St.
Wichita—721 Beacon Building.
KENTUCKY
Louisville—126 E. Main St.
Middlesboro—
LOUISIANA
New Orleans—819-21 Julia St.
MAINE
Portland—202 Commercial St.
MARYLAND
Baltimore—19 E. Lombard St.
Cumberland—1 N. Liberty St.
Salisbury—Opp. Fulton Station.
MASSACHUSETTS
Boston—(See Cambridge "A.")
Cambridge—241 Albany St.
Springfield—Napier St.
MICHIGAN
Detroit—Jefferson Ave. and Orleans St.
Grand Rapids—135 Ottawa Ave., N. Y.
Hancock—First National Bank Bldg.
Iron Mountain—215 E. A St.
Jackson—172 South Water St.
Saginaw—1902 N. Michigan Ave.
Sault Ste. Marie.
MINNESOTA
Minneapolis—334 N. First St.
Virginia—413 Chestnut St.
MISSISSIPPI
Vicksburg—1312 Washington St.
MISSOURI
Kansas City—1316-1318 W. Eighth St.
St. Joseph—920 S. Sixth St., Sta. "A."
St. Louis—(See East St. Louis, Ill.)
NEBRASKA
Omaha—1007-9-11 Jones St., Union Sta. P. O.
NEW HAMPSHIRE
Concord—77 South Main St.
NEW JERSEY
Camden—Delaware Ave. and Cooper St.
Jersey City—554-56 Henderson St.
NEW YORK
Albany—108 Third Ave.
Binghamton—21 Jarvis St.
Geneva—Exchange St. and Railroad Pl.
Jamaica—11 New York Ave.
Kingston—O'Neil St., near Broadway.
New York City—42nd St. Building.
Niagara Falls.
Poughkeepsie—Smith St. and N. Y., N. H. & H. R. R. Tracks.
Roscoe.
Utica—127 Hotel St.
Watertown—438 Court St.
Whitehall—57 Canal St.
NORTH CAROLINA
Wilmington—105 North Water St.
NORTH DAKOTA
Fargo—17-19 Broadway.
OHIO
Cincinnati—63-65 Plum St.
Cleveland—601 The Citizens' Building.
Columbus—310 Dublin Ave.
Dayton—812-828 E. First St.
Lima—338 East High St.
Toledo—414 S. Erie St.
Zanesville—Main and Second Sts.
OKLAHOMA
Oklahoma City—27-29 E. Grand Ave.
OREGON
Portland—Fifteenth and Hoyt Sts.
PENNSYLVANIA
Beaver.
Du Bois—Weber Ave. and Franklin St.
Erie—1426 Chestnut St.
Harrisburg—627 Walnut St.
Johnstown—129 Jackson St.
Pittsburgh—32nd St. and Penn. R. R.
Pottsville—Railroad and Sanderson Sts.
Scranton—4 Cliff St.
Shamokin—46 West Independence St.
Williamsport—Canal and Court Sts.
RHODE ISLAND ....
Providence—Allen's Ave., P. O. Box 419.
SOUTH CAROLINA
Charleston—153 Church St.
TENNESSEE
Chattanooga—700 E. Tenth St.
Knoxville—426 West Depot Ave.
Memphis—671 South Main St.
Nashville—105-107-109 Broadway.
TEXAS
Dallas—802-810 Cadiz St.
El Paso—900 Overland St.
Houston—Baker and Cedar Sts., Box 745.
San Antonio—Cor. Leal and N. Salado Sts.
Waco—633 S. 7th St.
UTAH
Salt Lake City—118 W. Second South St.
VERMONT
Burlington—College and Champlain Sts.
VIRGINIA
Lynchburg—1324 Commerce St.
Norfolk—Cor. First and Front Sts.
Richmond—18th and Cary Sts.
WEST VIRGINIA
Bluefield—295 Roanoke St.
Charleston—Broad St. and K. & M. R. R.
Fairmont—"A" Street.
Huntington—820 3rd Avenue.
WASHINGTON
Seattle—1102 First Ave.
Spokane—646 Peyton Building.
WISCONSIN
La Crosse—Front and King Streets.
Madison—309 East Wilson St.
Milwaukee—120-134 Jefferson St.

We recommend our customers to select from the list, the city from which the quickest delivery and lowest freight rate can be obtained, and address their orders to "Union Carbide Sales Company" at the distributing point selected accompanied by remittance.

Please address request for information or special correspondence to either the Chicago or New York office.

THE
BASTIAN-BLESSING
COMPANY

125-131 W. Austin Ave.
Chicago, Ill.

Generator Safety Valve

This diaphragm valve is positive in operation and absolutely safe. Approved by National Board of Underwriters on several generators.

Far superior to ordinary, old style safety because it is so designed that it opens and closes with minimum loss of pressure.

Write for our catalog.

We sell manufacturers and jobbers only.

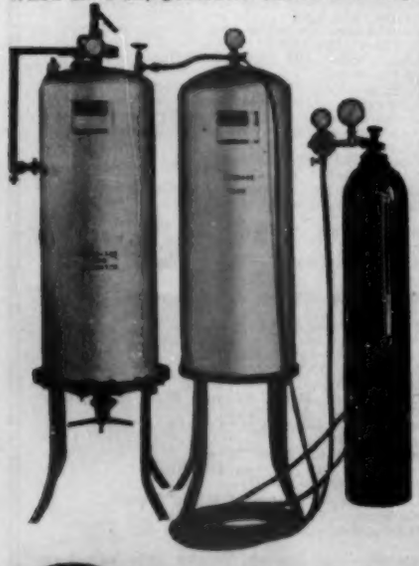
REGO TRADE MARK

THERMALENE — THE GAS OF GREATEST EFFICIENCY — THERMALENE

The Oxy-Thermalene Method
of Welding, Cutting, Brazing, Etc.

The only Acetylene Oil Gas generator in the world. Saves 25% on gas and oxygen. First class references. We also sell complete Oxy-Acetylene equipment for dissolved Acetylene for $42.00.

Thermalene gas in conjunction with Oxygen gas produces the ideal flame for welding and cutting. There is no loss of time due to shortage of gas. The generator works only when you work. When shut off, generator ceases instantly.



Thermaline will not produce faulty welds due to impure and moist gas. The generator may be mounted on a truck and made portable.

Thermaline Gas, being heavier and richer than Acetylene and other gases, has more body, producing a softer non-oxidizing flame, which assures a more uniform weld and a cleaner cut, without burning or making the metal brittle.

Write for full information, catalog and prices.

THE
THERMALENE
COMPANY
Chicago Heights, Ill.

THERMALENE — THE GAS OF GREATEST EFFICIENCY — THERMALENE

U. S. Gauge Company
New York

The MODERN ENGINEERING CO. has adopted the U. S. GAUGE as standard on their equipment. Its record in service, together with distinctive patented safety features commend it to the best trade.

New York, 67 Wall St.

Chicago, Clark Street Bridge.

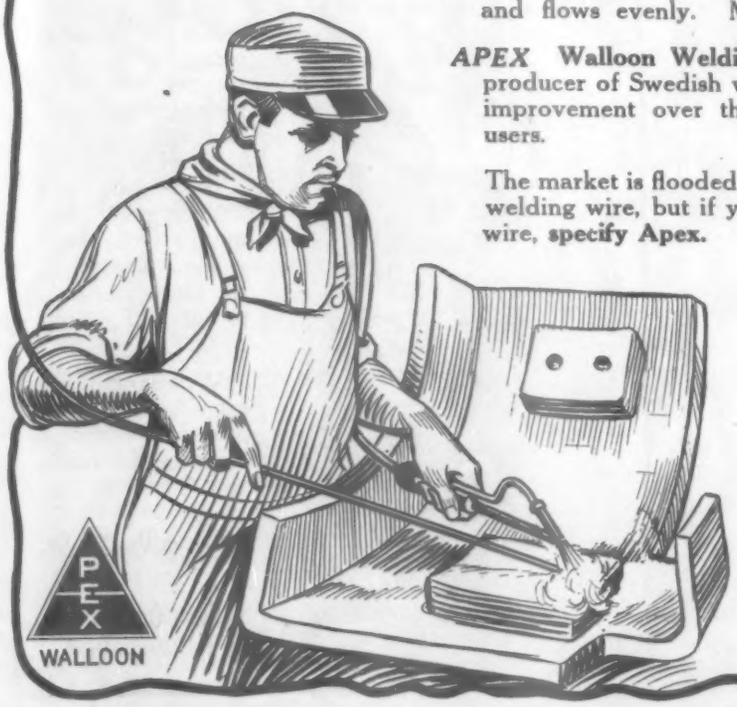
San Francisco, 681 Market Street.

Detroit, 42 W. Larned Street.

Montreal, Board of Trade.

Works: Sellersville, Pa.

Apex Welding Wire



APEX **Walloon Welding Wire** makes a strong, durable weld. It fuses at a lower temperature than ordinary wire and flows evenly. Makes a strong homogeneous weld.

APEX **Walloon Welding Wire** is offered by the pioneer producer of Swedish welding wire in this country. It is an improvement over the original product according to its users.

The market is flooded with cheap wire marketed as Swedish welding wire, but if you demand a really good economical wire, **specify Apex.**

Write for particulars and samples

APEX Steel Corporation

52 Church Street
NEW YORK

Canada Carbide Sales Company

30 Church Street
NEW YORK CITY

WORKS
Shawinigan Falls, Que.
Merritton, Ont.

Sales Agents of

CANADIAN CARBIDE

"More gas per pound"

SIZE PKGS.
100 lb. and 1,000 lb. 25-lb. drums; 10 lb., 5 lb., 2 lb., 1 lb. tins

Manuf'd in all standard sizes

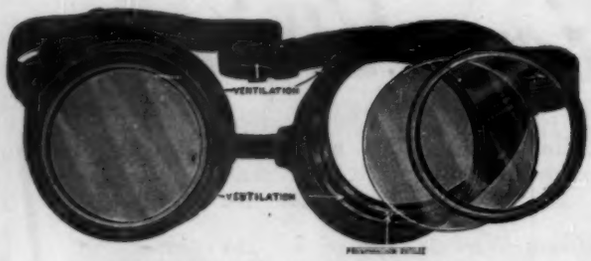
DISTRIBUTING STATIONS

ALABAMA
Bessemer—2014-2024 Second Ave.
CALIFORNIA
Los Angeles—52nd St. and Santa Fe Ave.
San Francisco—731 Market St.
ILLINOIS
Chicago—105 W. Monroe St.
IOWA
Knoxville.
Centerville.
Albia.
LOUISIANA
New Orleans—Camp and Common Sts.
MARYLAND
Baltimore—17 So. Hanover St.
MASSACHUSETTS
Boston—47 Oliver St.
Springfield—50 Taylor St.
MICHIGAN
Detroit—343 Bellevue Ave.
MINNESOTA
Duluth—Third Ave. E. and Michigan St.
MISSOURI
Joplin—Opposite Post Office.
NEW JERSEY
Newark—See New York.
Paterson—41-43 Washington St.
NEW YORK
Buffalo—Seneca and Hamburg Sts.
Malone—32-34 W. Main St.
Middletown—28 W. Main St.
New York—30 Church St.
Troy—6 and 8 Grand St.
Trumansburg—55 Main St.
Watertown—112 Franklin St.

DISTRIBUTING STATIONS

OHIO
Toledo—Address Detroit, Barton.
PENNSYLVANIA
Barnesboro—Ann St. and Maple Ave.
Johnstown—134 Clinton St.
Montrose.
Pittsburgh—2223 Farmers Bank Bldg.
Pottsville—Centre and Market Sts.
Punxsutawney.
Scranton—339 Penn Ave.
Wilkes-Barre.
RHODE ISLAND
Providence—543 Charles St.
TENNESSEE
Knoxville—1761 Asylum Ave.
TEXAS
Fort Worth—23rd and Jones Sts.
Houston—Address Fort Worth.
UTAH
Salt Lake City—121 W. 2nd South St.
VERMONT
Burlington—Park Ave.
VIRGINIA
Richmond—1319 E. Main St.
WEST VIRGINIA
Charleston—821 Virginia St.
Huntington—1032 Third Ave.

For special information address correspondence to New York City.



THE HARDY WELDING GLASS

That the large industrial concerns throughout the country realize there is only one safe welding eye protector is evidenced by the fact that we have been deluged with orders during the past four months for

THE HARDY WELDING GLASS
WITH NOVIWELD LENSES

WE SUGGEST YOUR ADVANCE ORDERS

The booklet describing this protector is free. Write for one.

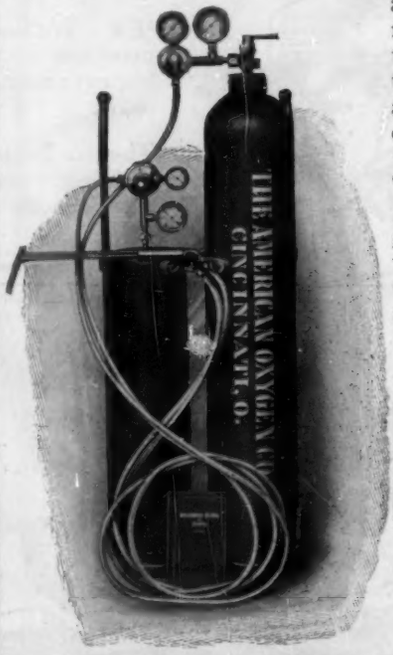
F. A. HARDY & CO.
JOHN H. HARDIN, Pres.

CHICAGO 10 S. Wabash Ave.
ATLANTA Grant Bldg.
DALLAS Praetorian Bldg.
NEW YORK 29 E. 22nd St.
SAN FRANCISCO Phelan Bldg.
DENVER Gas & Electric Bldg.

Pure Oxygen

Pure oxygen is essential to good work. If your oxygen supply is not up to the standard set by "American" and "Watergas" oxygen then the best welding and cutting apparatus to be had will not do your work properly.

We are glad to recommend "Vulcan" welding and cutting apparatus to our customers. No better tools are made and when used in connection with "American" and "Watergas" oxygen, with high grade acetylene, we know our customer will get results.



Write our nearest office for prices. Prompt shipments made at all times.

American Oxygen Co.
Cincinnati

Indiana Oxygen Co.
Indianapolis

Swift Oxygen

For Welding and Cutting

Unsurpassed for Quality

Pure Oxygen Electrolytically Made under the direct supervision of our Chemical Laboratory. It is carefully controlled by chemical analysis, thus insuring the highest obtainable purity.

We carry a large stock on hand so can fill orders immediately.

Swift & Company

Oxygen Department **Union Stock Yards, Chicago, Ill.**

Announcement Extraordinary!

ALUMINUM IMPERIAL SOLDER

A FEW USERS OF IMPERIAL ALUMINUM SOLDER

American Wood Rim Co.
American Body Co.
Ajax Auto Sheet Metal Parts Mfg. Company.
Bordens Condensed Milk Co.
Buick Motor Company.
Brewster & Company.
Chalmers Motor Company.
Detroit-Cadillac Motor Car Co.
Davis-Bournonville Company.
Ford Motor Company.
Fifth Avenue Coach Company.
H. H. Franklin Mfg. Company.
Interborough Rapid Transit Co.
Keystone Vehicle Company.
Lozier Motor Company.
Locke & Company.
Louisiana&Arkansas Railway Co.
The Mathews Company.

AT LAST!

A Perfect

SOLDER

for

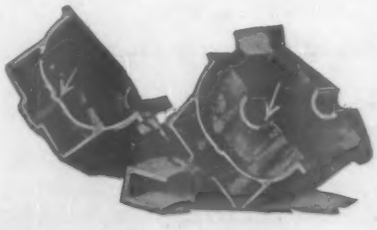
ALUMINUM

ALUMINUM IMPERIAL SOLDER

A FEW USERS OF IMPERIAL ALUMINUM SOLDER

Maxim Munitions Company.
Montgomery & Company.
Mercer Automobile Company.
Packard Motor Company.
Pennsylvania Railroad Co.
Stromberg Motor Devices Co.
Saxon Motor Co. of New York.
W. & J. Sloane.
The White Company.
Western Electric Company.
Mason-SeamanTransportationCo.
Duesenberg Motor Company
J.Frank Cutter,Cambridge,Mass
Knickerbocker Service St. N. Y.
William Woop, Inc., N. Y.
Curtis Motor Company. Hammondsport, N. Y.
F. B. Steans Co. of New York
Etc., Etc.

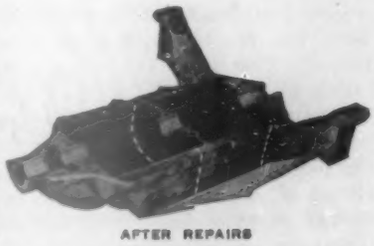
BROKEN ALUMINUM PARTS NO LONGER A LOSS!



BEFORE REPAIRS

The SCRAP HEAP no longer need claim broken or defective Aluminum parts, because any crack, break, or fracture, may be easily, speedily and permanently repaired and made good as new, with IMPERIAL ALUMINUM SOLDER.

This wonderful Solder flows readily at 350°F. and may be applied successfully by a novice. It renders the mended parts tronger if anything than the original metal. Numerous prominent concerns testify to the excellence of our product, and use it exclusively in preference to the expensive and uncertain process of welding, which requires great heat, always risking warps and other defects caused by high temperature.



AFTER REPAIRS

UNCONDITIONAL GUARANTEE

We offer IMPERIAL ALUMINUM SOLDER under an unconditional guarantee. If our product is not satisfactory in every way we will refund the price of the Solder, anytime within 10 days from date of purchase. We refer you to any of the above users. Send your order to-day and be convinced.

NATIONAL SOLDER COMPANY
INCORPORATED
SOLE MANUFACTURERS
1775 BROADWAY NEW YORK CITY

NATIONAL SOLDER CO., Inc. 1777 Broadway, New York

Date_____

Gentlemen:-

I am interested in Imperial Aluminum Solder. Please send me one pound for trial, for which I enclose $3.00. It is agreed if not satisfactory you will refund the price as stated in your guarantee.

Name_____

Address_____

Business_____

WELDERS' GOGGLE No. 3

White non-rusting metal, folding screens, all metal parts covered to prevent the frame from getting heated and burning the skin. Fastened on by an elastic head-band.

No. 3. Mounted with first quality, gray green glass .....$1.50 each
Mounted with the new American Noviweld glass .....$2.00 each
Quantity prices upon application

After experimenting for two years we have succeeded in producing a glass especially for Welders, equal, if not superior, to the German make. The Gray green glass used in our goggles is an American product.

The above goggles furnished with light smoked, blue, amber or clear white glasses

WILLIAM C. ADAMS
Manufacturer, Importer and Wholesale Dealer in
Welding Goggles and Protection Glasses
332 BOYLSTON STREET
BOSTON - - - MASS., U. S. A.
Write for Catalogue. Samples Submitted

Manufacturing Pipe to Sketch With the K-G Oxy-Acetylene Welding and Cutting Equipment.

The K-G Welding and Cutting Equipment is particularly well adapted to this line of work. The range of work that can be accomplished with K-G Torches is unlimited.
Drop in and see a demonstration.

K-G WELDING and CUTTING CO., Inc.
Shops and Offices at
556 West 34th St., New York City

Hints To WELDERS

Can you write intelligently about the welding work you do, or which is done under your supervision? That is to say, when you finish an interesting piece of work, can you set down on paper the manner in which you went about the job, how you prepared the work, how you preheated and how the job was done? Have you learned in the hard school of experience some little stunt which every welder ought to know? If you can answer yes to the above questions you are the man I am looking for. I'll pay you a fair price for that bit of experience and I'll print it in The Welding Engineer "Hints to Welders" where more than 4,000 of your fellows will see it. Write it down any old way—I'll polish it up. Make a rough pencil sketch and our draughtsman will fix it up fine. Line drawings are more practical than photographs. Do it today—the men on the firing line are waiting.

L. B. MACKENZIE, Editor

The Welding Engineer
608 S. Dearborn St., : Chicago

Just Published

Autogenous Welding and Cutting

By THEODORE KAUTNY

Translated from the German by the author and James S. Whiteford.

157 pages, 5x7½. 133 illustrations
$1.00 (4/2) net, postpaid

A translation of a standard German work giving in compact form for ready reference the important elements of the process. Every effort has been made to avoid the use of confusing technical terms and to give such information as will help the individual welder to a more thorough understanding and appreciation of the art.

CHAPTER HEADINGS

I. Autogenous Welding Flames. II. Acetylene Manufacture and Apparatus. III. Oxygen Manufacture and Apparatus. IV. Gas Mains and Fittings. V. Autogenous Welding Burners. VI. Autogenous Cutting Burners. VII. Autogenous Welding of Iron. VIII. Repairs of Gray Cast Iron. IX. Welding of Sheet Iron. X. Manufacture and Repairs of Boilers. XI. Manufacture of Cylindrical Vessels. XII. Manufacture of Rectangular Vessels and Miscellaneous Articles. XIII. Manufacture and Installation of Large Pipes and Conduits. XIV. Manufacture and Installation of Gas and Water Pipe. XV. Construction of Pipe-Shaped Apparatus. XVI. Welding of Copper. XVII. Welding of Aluminum. XVIII. Welding of Nickel and Other Metals. XIX. Conclusion.

THE WELDING ENGINEER
608 S. Dearborn Street, CHICAGO, ILL.

Universal

UNIVERSAL OXYGEN COMPANY
SHEBOYGAN, WISCONSIN, U.S.A.

PURE OXYGEN and HYDROGEN GASES
WELDING and CUTTING EQUIPMENT
Milwaukee Branch: 315 Fourth Street

WILLIS
OXY-ACETYLENE APPARATUS
WELDERS
MANUFACTURERS
of
Welding and Cutting Apparatus, Acetylene Generators, Lead Burning, Platinum Melting and Carbon Cleaning Outfits.
Gas and Oil Preheating Torches and Welding Fluxes, Rods, etc.
Write for Catalog.
Henderson-Willis Welding & Cutting Co.
2305-7-9 N. 11th St.
St. Louis, Mo.

Welding Plants for All Purposes
12 Sizes—Ranging in price from
$25.00 to $250.00
Write for catalog and our special 30 day offer.

A "BERMO" Plant means more profit for you.
Shipment made same day order received.
Liberal terms on plants if desired.
Address Department C.
Bermo Welding Apparatus Co.
Omaha, Nebraska, U. S. A.

BLOWPIPE TALK

No. 6-H Blowpipe, Natural Gas, $3.00

"If you have a blowpipe for natural gas that is a success, please send it by return mail."
ONE WEEK LATER
"Your blowpipe arrived and it is a dream."
This is only one of many such instances we experience as manufacturers of efficient blowpipes.
If you have blowpipe troubles, why not submit them to us? Write for catalog "B. X." today, listing our complete line, ranging from the smallest, for jewelers' and dental work, to the largest, for general workshop use.
Buffalo Dental Manufacturing Co. **Buffalo, N. Y., U. S. A.**

Use either electrode at will, all adjustments are automatically made by G-E Arc Welding Outfit

Welding Seams on Locomotive Firebox

Cuts Repair Cost—Saves Time

If chippers are busy elsewhere don't wait—let the G-E arc welder do its own chipping. Don't even take time to remove a flat wheel—the G-E arc welder will build it up while in place. You can control heat and building of metal, thus preventing distortion, uneven crystallization and cavities.

The G-E arc welder is used all over the world. It has made good in China; it is making emergency repairs for the Suez Canal and the rapid transit rolling stock of New York City is kept in shape by its help.

Our nearest local office will be pleased to give you additional information.

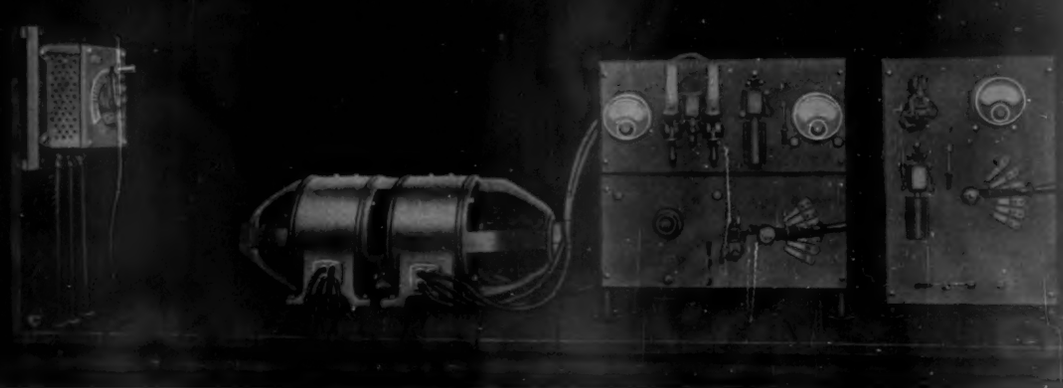
General Electric Company

General Office: Schenectady, N. Y.

District Offices in:

Boston, Mass. New York, N. Y. Philadelphia, Penna. Atlanta, Ga.
Cincinnati, Ohio St. Louis, Mo. San Francisco, Cal. Chicago, Ill. Denver, Colo.

Sales Offices in All Large Cities 6120



AMERICAN CARBOLITE SALES COMPANY

DISTRIBUTORS OF

CALCIUM CARBIDE

TRADE Carbolite MARK

Large and complete stocks of all standard sizes, packed in drums and cases, carried on hand at the following distributing points:

COLORADO
Denver
Victor

ILLINOIS
Benton
Chicago
Decatur
Peoria
Springfield

INDIANA
Evansville
Indianapolis
Terre Haute

IOWA
Albia
Centerville
Davenport
Des Moines
Knoxville
Ottumwa
Sioux City

KANSAS
Atchison
Pittsburg

KENTUCKY
Louisville

LOUISIANA
New Orleans

MICHIGAN
Bay City
Grand Rapids

MINNESOTA
Albert Lea
Duluth
Minneapolis

MISSOURI
Joplin
Kansas City
St. Joseph
St. Louis

MONTANA
Butte

NEBRASKA
Omaha

NORTH DAKOTA
Fargo

OHIO
Cleveland
Columbus
Salem
Toledo

OREGON
Portland

PENNSYLVANIA
Harrisburg
Wyoming

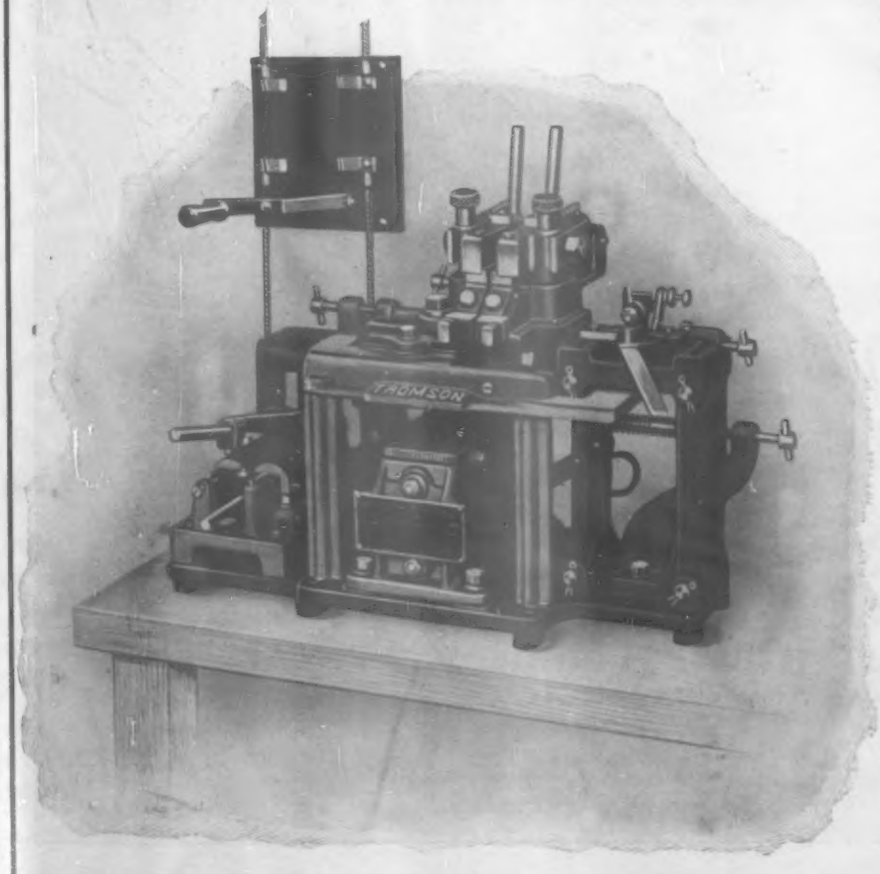
UTAH
Salt Lake City

WASHINGTON
Seattle
Spokane

WEST VIRGINIA
Bluefield

WISCONSIN
Madison
Milwaukee

Please address request for information or prices to General Office, Duluth, Minn.



The "Thomson" Electric Welders

A Modern Way, Yet Not New. Quickest — Cheapest — Best. No Smoke, Heat, Dirt or Glare. Easy — Swift — Sure. No Expensive or Expert Workman — Always Ready. Current Cost Small.

Type 1-A Electric Welder

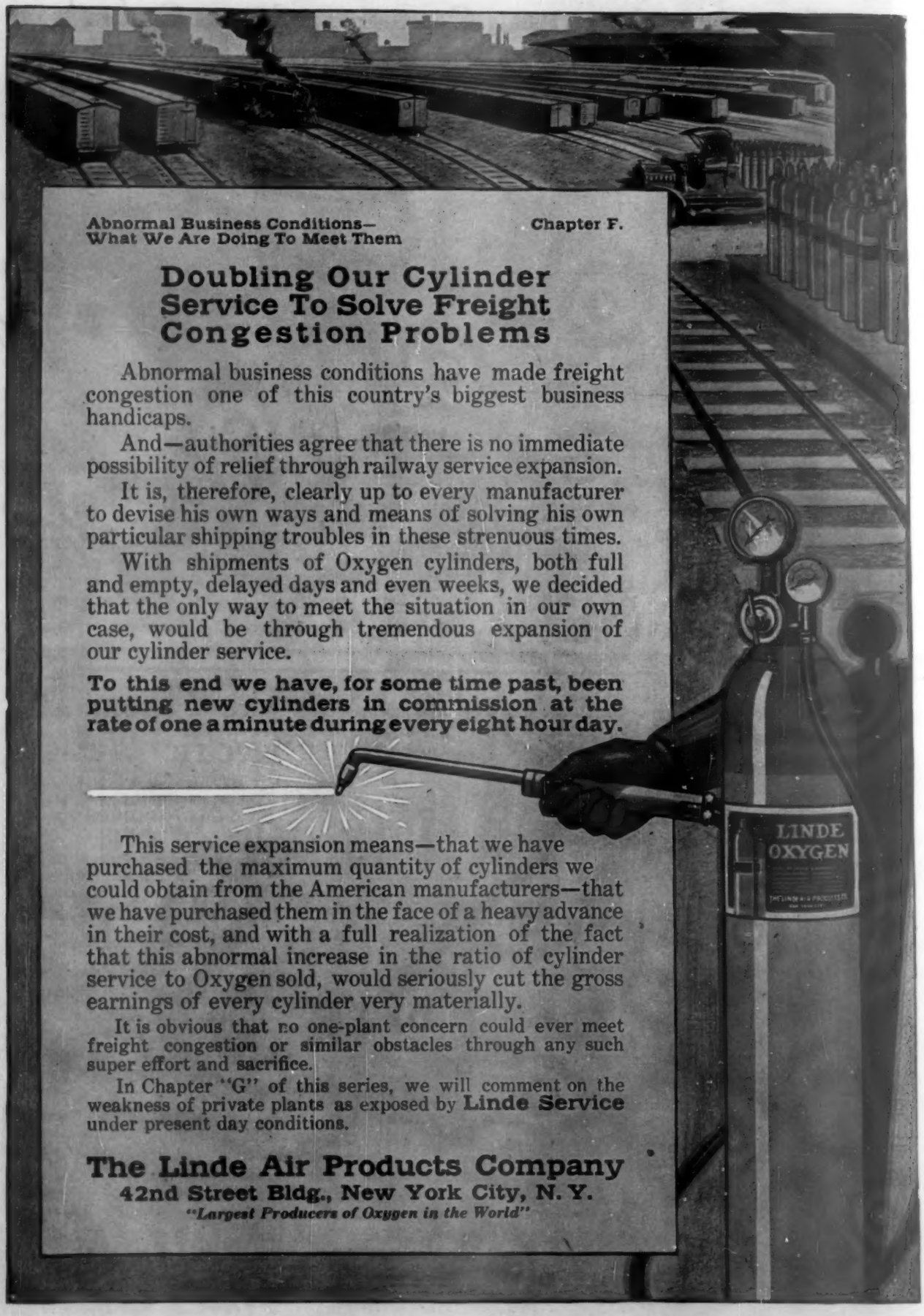
Capacity up to No. 10 Wire

Steel, brass, platinum and special steels together or in combination. 1500 watts 1 second. Less than 1 KW. hour 1000 welds. 14x24x16 inches high. 120 pounds.

Describe the shape, tell us the size of the smallest and largest piece, the maximum number of welds required per day, the cost of current per kw. hour; we will then tell you what it will cost you to electric-weld. If you haven't an alternating current, your local Lighting and Power Company has.

Weld Your High-Speed Steels
We Job Weld Also

Thomson Electric Welding Co.
Lynn, Mass.
The Pioneer Manufacturers



Abnormal Business Conditions—
What We Are Doing To Meet Them

Chapter F.

Doubling Our Cylinder Service To Solve Freight Congestion Problems

Abnormal business conditions have made freight congestion one of this country's biggest business handicaps.

And—authorities agree that there is no immediate possibility of relief through railway service expansion.

It is, therefore, clearly up to every manufacturer to devise his own ways and means of solving his own particular shipping troubles in these strenuous times.

With shipments of Oxygen cylinders, both full and empty, delayed days and even weeks, we decided that the only way to meet the situation in our own case, would be through tremendous expansion of our cylinder service.

To this end we have, for some time past, been putting new cylinders in commission at the rate of one a minute during every eight hour day.

This service expansion means—that we have purchased the maximum quantity of cylinders we could obtain from the American manufacturers—that we have purchased them in the face of a heavy advance in their cost, and with a full realization of the fact that this abnormal increase in the ratio of cylinder service to Oxygen sold, would seriously cut the gross earnings of every cylinder very materially.

It is obvious that no one-plant concern could ever meet freight congestion or similar obstacles through any such super effort and sacrifice.

In Chapter "G" of this series, we will comment on the weakness of private plants as exposed by **Linde Service** under present day conditions.

The Linde Air Products Company
42nd Street Bldg., New York City, N. Y.
"Largest Producers of Oxygen in the World"

The Welding Engineer

Published on the First Thursday of Each Month by

THE WELDING ENGINEER PUBLISHING CO.,
608 S. Dearborn St., Chicago, Ill.
Telephone Wabash 7134.

L. B. Mackenzie.....President and Editor

Subscription payable in advance and postage free.
United States, Canada and Mexico.....$2.00 a year
Foreign Countries ..... 2.50 a year
Single copy, domestic .....20 cents
Single copy, foreign .....25 cents

Entered as second-class matter January 20, 1916, at the postoffice at Chicago, Illinois, under the act of March 3, 1879.

The Welding Engineer is a member of the Audit Bureau of Circulations.

We guarantee that of this issue more than 4,000 copies were printed, excluding copies spoiled in press room and bindery. At the time of mailing the known distribution was (actual count always exceeds press order):

Copies to paid subscribers	1,846
Copies to advertisers	61
Copies to prospective advertisers	143
Copies to other trade papers, correspondents, etc	10
Copies mailed as samples to prospective subscribers	1,630
Copies retained at office of publication to fill new subscription orders, etc	300
Copies for office use	10
TOTAL	4,000

VOLUME 1. OCTOBER, 1916. NUMBER 10.

Practice for Students.

THE medical schools experience no more trouble in securing the necessary cadavers, upon which students practice the gentle art of dissection, than do welding schools in securing a diversified supply of broken machines and parts, the repair of which will in time make a welder. There is this slight difference: should the medical student make the unimportant mistake of removing the liver instead of the appendix, no serious harm is done. The student is merely lectured for carelessness. Should a student of welding, however, melt down an aluminum crank case, left for repairs by some trusting owner, it's another matter. The subjects relative, so to speak, is apt to insist upon satisfaction and he is also apt to blame it all on the welding system.

We are informed by the secretary of the British Acetylene Welding Association that "the work of the welding classes, as established in the United Kingdom, has never interfered in any way with the work of serious industrial concerns, the practice of their welding being usually confined to welding scrap material. The classes are indebted to friends for their supply of this scrap for welding practice."

Business Conditions.

THE fall of the year is naturally the season of greatest trade activity. The crops go on the market at this time and cause a wide distribution of funds, the preparations for winter mean a heavy retail trade, the transportation lines are usually at their maximum traffic and nearly all industries are normally busy. Last year the volume of business crept slowly upward through the first eight months and rounded into full activity in the fall. Since then there has been no let up, and about the only difference apparent as we come again into the fall season is that prices are rising. When all agencies of production are driven to capacity an increasing demand works itself off in this manner.

There is more confidence in the future than has been felt at any time in the last two years. This does not mean that there are no apprehensions of an industrial slump after the war, but that with the profits of the last year applied to indebtedness or added to resources, the position of the industries is inherently stronger. Moreover, there is a feeling that business is accumulating which will come forward when war orders are out of the way. In nearly all lines there is difficulty in getting orders filled. Foreign trade in ordinary merchandise in all parts of the world is growing, because there is no other place to get the goods and this fact will prevent any accumulation of stocks until some time after the war.

The iron and steel situation is stronger than ever. Prices are higher in nearly all lines. It goes without saying that no consumptive demand which can be postponed is contesting for supplies on the present level. The railways have finally come into the market for cars and other equipment which is imperatively demanded. The requirements of the ship building industry are very heavy, and likely to be so for several years to come. General construction, and the work involved in new enterprises is light, but there is a large amount of building for the enlargement of industries that are now pushed to capacity.

Efficiency Equipment.

NOBODY can make as much money in a poverty-striken community as in a rich community. If everybody in the United States could be kept in health and completely employed all the year round, and made skillful in some occupation, the volume of business and the rise of wages and profits would outstrip the records of this war boom, and it would be permanent business.

The most important economic factor in industrial organization today is the equipment with which men work, the machinery, the material industrial plant. The mechanical plant multiplies the workman's capacity over and over. It not only multiplies his capacity, but as a rule, enables him to do the work more easily. Compare the manual labor, the toil necessary to produce a bushel of wheat or a ton of steel with the effort necessary fifty years ago. Everywhere in industry we see this process of increasing the productiveness and easing the toil of labor by providing better tools. This improvement of industrial plants is clearly in the common interest.

Good Buyers.

IF YOU care to consult Mr. Dun and Mr. Bradstreet you'll find out that there is about one concern in fifty which succeeds in business. And if you could study the successes, from an inside point of view, you'd learn that good buying had a lot to do with it.

You can't become a good buyer unless you keep constantly in touch with the best things being sold in your line. And you can't do this unless you read the ads.

The day is past when ads are merely tolerated, like the train-boy who tries to sell you everything from hemp cigars to souvenir post cards.

Someone once truly said "Proportionally as a man's backbone weakens his 'wishbone' develops." Good buyers have good backbones—

Cast iron requires a slightly larger tip than steel. Its melting point is lower than steel, but it absorbs heat more readily. Aluminum, although its melting point is comparatively low, requires a larger tip than for steel of the same section. This is because aluminum conducts the applied heat, that is, spreads it to all parts of the structure, very rapidly, and its specific heat, or ability to absorb heat, is very high.

The Development of Welding in the Sheet Metal Industry

By J. B. Diehl

That the introduction of oxy-acetylene welding in the sheet metal field is responsible for some of the most radical and important improvements made, is acknowledged by the leading manufacturers in this and other countries; some employing as high as seventy-five operators welding continuously.

This is especially true with respect to the manufacture of sheet steel equipment, notably doors, window sash, steel railroad cars, automobile bodies, tanks, etc.

A foremost difficulty encountered by the pioneer manufacturers was the absence of a known economical and practical method for making reliable joint connections between the various sections. They had recourse only to the old methods of riveting, seaming, splicing, soldering, etc., none of which gave the required strength and economy of production.

Because of the lightness of the material, and the abuse to which it was subjected, it was frequently found that these joints would not stand up, often owing to reinforcing plates underneath coming loose.

All this has been eliminated by oxy-acetylene welding, which has made possible the welding together of almost any type of sheet steel construction, making practically one

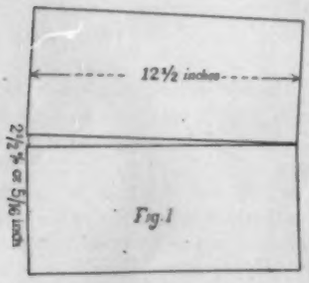


Fig. 1

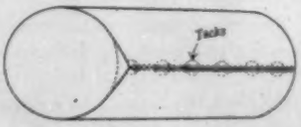


Fig. 2

piece. Before this advent, this result could only be obtained by various deep drawing methods, which was very expensive, making it practical only for certain classes of work.

Furthermore, manufacturing sheet metal products by the oxy-acetylene method produces far more satisfactory results than are possible by riveting or other means, as the finished product is not only stronger and more uniform, but the joints are air and liquid tight. Naturally, as this new, highly efficient process was adopted, problems arose that required considerable experimenting and study.

Two of the principal ones were, to eliminate buckles, and distortion of shape.

This has been found to be best accomplished by the use of suitable jigs and clamping arrangements, together with allowances being made for the expansion of the metal.

Restricted expansion may be likened unto "an irresistible force moving against an immovable body." In welding light sheet metal, as the metal under the flame becomes heated, it expands, requiring more space. If this space is denied by the outer or cold metal, the expanding metal will take the easiest course.

Owing to its ductility, it will either rise or fall, forming a buckle. The greater the surface heated, together with intensity of heat, the greater the buckles. On the other hand, if this heat is confined to a small space and welding edges are parallel, upon welding a short distance the edges will spread, after which it will be noticed they commence to creep or overlap, as this is an easy avenue of escape. In the welding of light gage sheets, if sheets are clamped down tight upon a table to offset this difficulty, as weld cools it will crack, owing to restriction of the metal as it contracts.

In accordance with the laws of metallurgy, metal when heated expands; therefore provision must be made to take care of the expansion before welding is started where this is possible.

The welding together of large sheets of light gage metal should never be attempted without suitable equipment. For manufacturing work a large cast iron plate about 5 inches thick is used, having slots one inch square machined in top, the entire length of casting. The edges are then placed over slot, which provides air space and eliminates unduly conduction.

Bars approximately 1 inch by 5 inches by length of weld are placed on each sheet, allowing a space of about one and a half inches for tip manipulation.

This confines the heat to such a small space that the rigidity of the weld holds the metal firm upon heating and cooling.

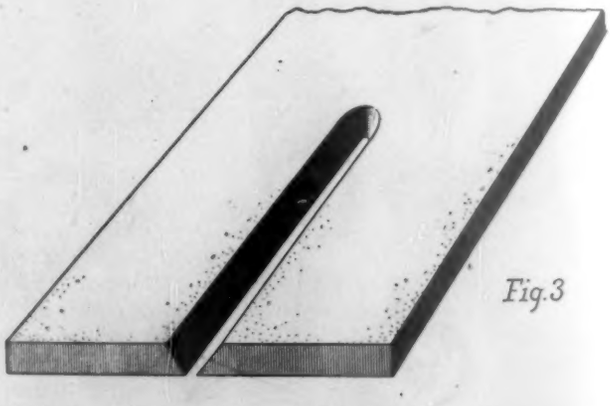


Fig. 3

An overhead arrangement employing adjustable arms is then brought into play to hold bars securely. The bars should never be clamped down tight, as their mission is only to hold sheets firm on table and to minimize heated surface.

In the jobbing shop this class of work can be handled successfully by the use of two I beams placed parallel to each other with a space of one inch between. Bars are then placed on top of sheets and clamped into position with C clamps.

In sheet or plate welding, the proper judgment of alignment preceding the operation is one of the foremost factors for success. If the space between the sheets is too small it will result in lapping, or, if they cannot rise to lap, the result will be what is known as crowding, so that buckling is inevitable. Where space allowance is too liberal, the result very frequently is unreliable welding.

It is inadvisable to weld lapped sheets for three reasons, i. e., poor appearance, altering dimensions and unreliable welds which is the same as not melting through a butt weld, always leaving a possible chance to start the seam again. This is especially objectionable in the welding of parts subjected to pressure.

To overcome this difficulty, allowance should be made for the expansion and contraction of the metal largely depending upon size, thickness, heat applied and speed of welding.

For general work, the sheets are placed in position as in sketch No. 1, in which the opening allowed at farther end of sheets is 2½% of total length of weld. Some instances require as much as 6% allowance, depending upon whether the welding operation is to be continuous or not.

Where welding is alternating, a greater allowance must be made to offset effects of shrinkage as weld becomes set, as this prevents the edges from resuming their previous position. See scale of allowances.

After welding is started, if edges close too quickly a wedge may be forced into opening restricting this action considerably; although this is liable to cause distortion if allowed to go too far. When edges do not close quickly enough, heating the edges to be welded will often bring the desired results, after which they are tacked.

On some classes of work, owing to its shape, these methods are not practical, therefore we must resort to tacking, or welding edges together in spots every few inches preliminary to the main welding operation. After tacking, the seam is straightened, this being essential for good welding. This system, however, is likely to cause distortion (see sketch No. 2), as expansion cannot act laterally, although this can be removed by drawing with the hammer.

Flanging, another system of merit, gives very good results on certain classes of work.

This is accomplished by bending edges of the metal up at right angles to the sheet about ⅛ inch. Upon bending these edges, the metal at the base of the flange will be stretched; therefore, as heat is applied to the flange, a considerable portion of the expansion is taken care of. An excellent feature of the flanging system is the elimination of the filler wire, it being only necessary to melt flange edges together.

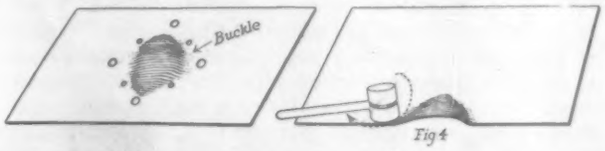


Fig 4

Cast iron forms under the metal are used in welding difficult shapes, while a slotted casting is clamped over joint. These slotted castings may be used on short flat, as well as irregular work, being casted to meet requirements at a small cost. See sketch No. 3.

As some work coming from the presses does not conform with the shape of these castings, asbestos sheet is placed between the sheet metal and top casting filling in all irregularities.

When a fine finish is required, best results can be obtained by making the weld on inside whenever practical to do so, as less time is required in finishing and added metal remaining on inside gives a stronger joint. Care must be exercised to melt metal through, otherwise a good finish cannot be obtained.

In the jobbing shop where the owner does not find it advisable to have these forms, he must resort to laying wet asbestos or other cooling mediums on each side of the seam to check the heat. As this does not always give the desired results, the welder should have some knowledge of removing the ensuing buckles. This knowledge will often help to remove the buckle problem entirely.

A buckle is simply more metal in a given space than belongs there. By trying to pound this down we do more harm than good, i. e., pushing the metal from the center toward the outer resisting metal. As this is the expansion problem over again, the result is a greater buckling.

To remove a buckle, a sheet metal worker's block or any shaped piece of smooth metal should be held underneath, or if large sheets, they can be placed upon a table. A wooden mallet or a coppersmith's hammer is used for the drawing process, exercising care that the metal is not stretched unduly.

Handle is held parallel to plane of the work, blows should be light and struck squarely on the metal, otherwise the metal would show hammer marks.

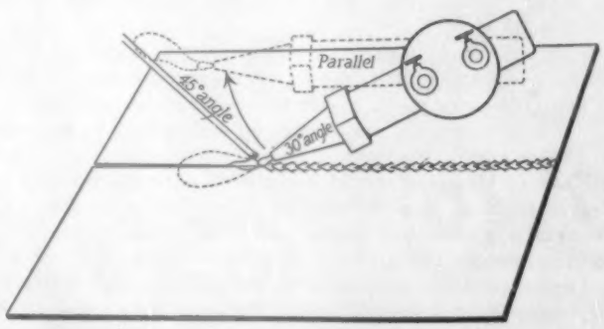
Assuming the buckle covers the space of a two-inch circle, we would start about one inch outside of this. In bringing the tool down on the metal it is drawn toward the workman, drawing the metal away from the buckle as shown in sketch No. 4, completing a circle around the buckle.

If metal is not then drawn taut, complete another circle inside of this, using about four blows, according to size of buckle, until it disappears, the idea being to bring the inner metal out to take the place of that just drawn out. However, the outer metal must always be drawn first to allow for this action.

Where several are to be considered in close proximity, the outer ones must be eliminated first.

Where considerable job work is done, a handy contraption for shaping sheet metal can be made with sand encased in leather, which is sewed around the edges.

On hollow parts, as with pressed steel doors, etc., the block cannot be used; therefore, the oxy-acetylene flame plays an important part. In welding this class of work a channel iron of ⅛ metal is spot welded inside of panel at



the joint. Upon clamping the slotted casting over the joint, this support greatly diminishes the tendency of the metal to sag. However, there are numerous instances where hollow shapes cannot be treated this way; therefore the chance of buckles is greater. Removing them on light work requires the use of a small tip, used in conjunction with water. Start should be made about one inch outside of buckle, holding the torch with the small white cone touching the metal until a spot appears dark, cherry red, resulting in the expansion of this part, care being taken not to melt the metal. Torch is quickly withdrawn, and spot quenched with water to stop contraction. About four spots of this nature encircling the buckle will cause the surplus metal to be mostly distributed. A few light taps with the hammer as described above will remove the buckle entirely. The thickness of metal and size of buckle must always be taken into consideration and worked accordingly.

When applying flame, care must be taken not to allow too much heat to radiate into buckle, as this would conflict with the purpose of the process. Flame should be pointed away from buckle and worked very quickly.

These methods apply to plate work as well as light gage metal, allowances to be made for different sizes.

A great many of the larger sheet metal shops use spring power or trip hammers for removing buckles, these being very speedy and efficient. By this method the work is moved around under the hammer, whereas the hand operation is completed by moving the hammer over the metal. Both instances are worked on the same principle.

The manipulation of the torch being an important factor in the welding of plate and sheet metal, several of the best

methods are herewith described. The ones in general use are: The oscillating motion for heavy work; circular motion for medium work; the Swish weld, which can be used on medium work and for finishing on heavy metal; and the Fade-a-Way weld for light work, this being probably the fastest method known, comparing favorably with machine welding. On heavy work the wire hand should be given a circular motion to puddle the metal well.

As there appeared in the August issue two excellent descriptions of the oscillating and circular movements, it would be superfluous to go over these again. On some classes of medium work the rippled effect resulting from the circular movement is not desired; therefore the Swish weld is substituted, making a smooth weld that is more easily finished off if welded properly.

The Swish weld is completed by holding the tip almost vertical to the plane of the weld, with handle at right angle to same, although on heavier work it is often more advantageous to work in line with the weld. When edges of the metal arrive at the melting point, wire is held before the small cone; as the fusion point is attained the torch is brought forward by a sharp movement of the hand.

This action places the drop and swishes the molten metal ahead, leaving a comparatively smooth path. As the operator learns to melt the edges and wire simultaneously, following up with the swish movement, he will find it very easy to make a neat, rapid weld with less ripples than by any other method.

This system is also used extensively in finishing boiler welds, and many others that do not require grinding or filing.

The fade-away weld, which requires considerable practice to be done correctly, may easily be understood by referring to sketch and instructions.

Head of blowpipe should be inclined with the tip at a 30-degree angle to plane of weld to secure fullest benefit of the secondary preheating flame, which is essential for speed welding, handle being at right angle to the seam.

The small cone is allowed to touch the metal, while the feed wire is held directly before the cone. As edges of the metal melt, the wire held at a 45-degree angle is brought under the cone, melting instantaneously, fusing edges and wire together.

To describe the movement of the torch hand, we may say that the hand and forearm is given an eccentric motion. As the edges melt, the wire hand is brought toward the torch, as described above. The hand is then turned, raising the tip from the 30-degree angle until it is parallel with weld.

To secure speed and neat workmanship by this method, it is absolutely necessary to get the correct movement of the hands. In an effort to make these movements plainer, we might say: when edges are ready to melt, and the wire brought toward the torch under cone, the torch is brought forward with an upward turn, taking a drop of the wire and placing it as shown in sketch with a herring-bone effect that is pleasing to the eye. (See note at bottom of this page.)

As the torch moves forward on the upward turn, placing the metal, the wire hand is moved backwards. As the torch goes down- or backwards, the wire is brought forward continuously administering these drops.

By using the correct size tip and wire, together with a properly prepared job, this action is continuous, making a neat, narrow weld, the speed of performance depending upon the skill of operator.

Scale of Allowances.

2 %=¼-inch opening for every 12½ inches length.
2½%=5/16-inch opening for every 12½ inches length.
3 %=⅜-inch opening for every 12½ inches length.
3½%=7/16-inch opening for every 12½ inches length.
4 %=½-inch opening for every 12½ inches length.
4½%=9/16-inch opening for every 12½ inches length.
5 %=⅝-inch opening for every 12½ inches length.
5½%=11/16-inch opening for every 12½ inches length.
6 %=¾-inch opening for every 12½ inches length.

Upon melting through the metal, the upward turn of the torch brings the molten metal up and forward, that would otherwise form a projection underneath the weld. This effect could better be called an overlapping pear-shape as is obtained in lead burning.

WHY BLAME WELDING APPARATUS?

If welding be done in a hand forge, and a poor weld results, the man—not the forge—is criticized. Ages of forge welding have proved that such work can be done. In other words, precedent and experience are the guides for our opinion and decision.

However, when a weld is made with an oxy-acetylene apparatus and the work fails, or is unsuccessful, the blame is too often placed on the apparatus—not the man. The reason for these two attitudes is no doubt owing to the fact that the oxy-acetylene apparatus is comparatively new.

The American Machinist during the past three years has shown sufficient examples and given enough data to prove that welding can be and is successfully being done by the oxy-acetylene method. These articles have not been limited to any one make or type of apparatus, but examples from high-, low- and equal-pressure apparatus have been illustrated.

With this evidence it seems that when cases of welding failure do occur, it would be fair to the makers of the apparatus to first prove that the fault is not with the man using it.

It is the business of the makers to produce an apparatus that will weld successfully, and in fairness it might be said that most of them do this for even the most exacting conditions. Often when a bad or insecure weld does occur, it is caused by an inexperienced operator using an incorrect type of flame obtained with the wrong mixture of gas, or perhaps through selecting the wrong size of welding tip.—American Machinist.

When grinding aluminum, the wheel is apt to gather the particles of aluminum and prevent grinding. It is pointed out by E. J. Hansen that a little grease or lard oil on the face of the emery wheel will prevent the particles from sticking and thereby insure the wheel cutting smoothly and to its maximum efficiency.—American Machinist.

Steel castings should be handled in a manner similar to cast iron. They may be preheated and prepared in the same way. Cast steel as a rule has a percentage of carbon between that in mild steel and grey cast iron. As a filler use cast bars of same material. If not available use Vanadium or Norway filler.

INTENSE OR HARMFUL LIGHTS.*

The importance of protecting the workmen from injurious lights needs no discussion. Through neglect to take necessary precautions the services of valuable men may be lost. In addition, errors in judgment, due to impaired eyesight of the employee, may prove expensive to the operator. An error on the part of the Bessemer blower, for example, may cause the loss of the blow or the complication of the process. Such occupations as those of metal grinding or buffing, where the workman is required to watch more or less intently a bright surface, may injure the eye. Harmful lights are found mostly in steel plants, foundries, or forge and weld shops. In addition several lights highly injurious to an unprotected eye have recently come into use, such as the arc weld, oxy-hydrogen and oxy-acetylene flames, and the thermit weld.

---

*Technical paper No. 102, Department of the Interior.

Light may be harmful either because of its intensity or because of its spectrum. It is possible also that radiant heat energy may have some effect upon the eye. The various lights to be met and the temperatures, in degrees of Fahrenheit, that accompany them are as follows:

Process.	Temperature.
Electric arc	6,200
Electric arc under pressure	6,450
Oxy-hydrogen flame	3,600
Oxy-acetylene flame	4,350
Thermit weld flame	4,500
Metal at tapping hole	2,300 to 2,700
Metal at tuyères (blast furnace)	2,300 to 3,500
Open-hearth furnace flame	3,400 to 3,600
Bessemer converter	3,400 to 3,600
Open hearth in ladle	2,800 to 2,900
Bessemer	2,800 to2,900
Soaking pits:	
Low-carbon billets	2,500 to 2,600
High-carbon billets	2,200
Gas-heating furnace	2,400 to 2,800
Large gas-heating furnace	2,900 to 3,200

Goggles.

The best way to avoid injurious effects from the lights mentioned is to protect the eye with glasses or goggles of special coloring or composition to meet the character of the light. Such goggles should have the following features:

(1) Shut out harmful rays.

(2) Reduce the retinal image to a safe brightness.

(3) Not unduly hinder vision of other objects besides those on which the employee is working.

(4) Be light in weight, well fitted, and as comfortable to wear as possible.

(5) Have no metal parts that touch the skin.

(6) Be fitted with a flange back of each lens so as to prevent glass from entering the eye in case the glass is broken by flying objects.

(7) Be of such coloring that color perception is not unduly disturbed.

The requisite last mentioned is important where the eye is to judge, from color and appearance, the condition or temperature of the material being heated. Therefore, in choosing goggles, the intensity and character of the light, the heat which may attend it, and the character of the duties of those workers that are to wear them should all be considered. The comfort of the wearer must be considered in order to overcome his natural disinclination to wear these protective devices.

Investigation of the spectral position of the light from the flames and processes mentioned has been made, and by photography and experimentation glasses of a certain coloring and composition have been devised that at least greatly reduce the hazard. A number of protective glasses now on the market seem to meet most requirements. Some have an advantage in that the relation of temperature, intensity, and color of the light appear much the same to the protected as to the unobstructed eye—an important item. The use of smoked glasses has been found unsatisfactory because they interfere with proper color discrimination and offer little protection.

In order to cut down the intensity of a light to safe brightness a neutral-tinted glass is the best so far devised. The density of this neutral glass should be varied to meet the intensity of the light to which the worker is exposed. For oxy-hydrogen or oxy-acetylene flames it may be of less density than for arc welding; and for the light from molten iron, steel, or other metal, a still lower density will suffice. For the light of an open hearth or of the open hearth steel a clear cobalt blue glass has been found best. In welding processes, except the lapweld, etc., the glasses are preferably fitted into a helmet that is light, well ventilated, and as comfortable to wear as possible. Employees should be furnished with goggles, and should be instructed in their use and in the importance of avoiding the hazard that may accompany the lights they meet in their duties. The employers should see that the goggles are worn. Each workman should be given a set for his use, and should be required to keep them clean and in order, to report when they are broken, and to receive new lenses immediately; he should be prohibited also from exchanging glasses with a fellow workman. Glasses, or other protective devices, when surrendered by one worker, should be thoroughly cleaned before being issued to another.

Another injurious light making goggles highly desirable is from the sudden and blinding flashes that occur at times around electrically operated machinery. Such flashes may be caused by the arc of a short circuit when a fuse blows out, by loose connections, by separation of electrical contacts, by too strong arcs, by loose and defective wiring, or other conditions. Such flashes may cause a severe inflammatory and painful condition of the eyes, and may result in temporary or permanent loss of vision.

Accidents and injuries to the eyes are among the most common that happen to a worker. Aside from the suffering of the worker there is inconvenience to the employer and a distinct economic loss to the public. Statisticians estimate that there are more than 80,000 men in the United States who are blind because their eyes were not protected while at work. This is a fearful indictment against the negligence of the persons responsible.

NICKEL PLATING.

Light nickel plating can be made by heating a bath of pure granulated tin, argol and water to boiling, and adding a small quantity of red-hot nickel oxide. A brass or copper article immersed in this solution is instantly covered with pure nickel.

In soldering electrical apparatus, a writer in "Power" points out that nothing but a rosin flux should be used, as it is free from injurious acids and is a fair insulator. It can be applied in lump or powdered form, or as a paste by dissolving it in alcohol. There are several handy combinations of rosin-solder on the market, such as a slender tube of solder filled with rosin so that in use the flux is applied as the solder is melted and applied. Prepared solder pastes and fluids may be bought, all of which are more or less satisfactory and convenient to use. A strong acid solution can be made by dissolving scraps of sheet zinc in muriatic acid, a little at a time to avoid generating too much heat, taking care not to inhale the acid fumes.

The welding flame will be found useful as a source of heat for the heat treatment of small tools.

Gear teeth may be hardened by playing the welding flame along the face of a tooth, and then allowing the heat to be conducted away by the body of the gear. The intense heat of the flame permits of a single tooth being heated very rapidly before much heat is conducted to the rest of the gear. As soon as the flame is removed the heat in the treated tooth is conducted away to the body of the gear. This causes hardening of the tooth. This operation is repeated until the desired depth of hardening is reached.

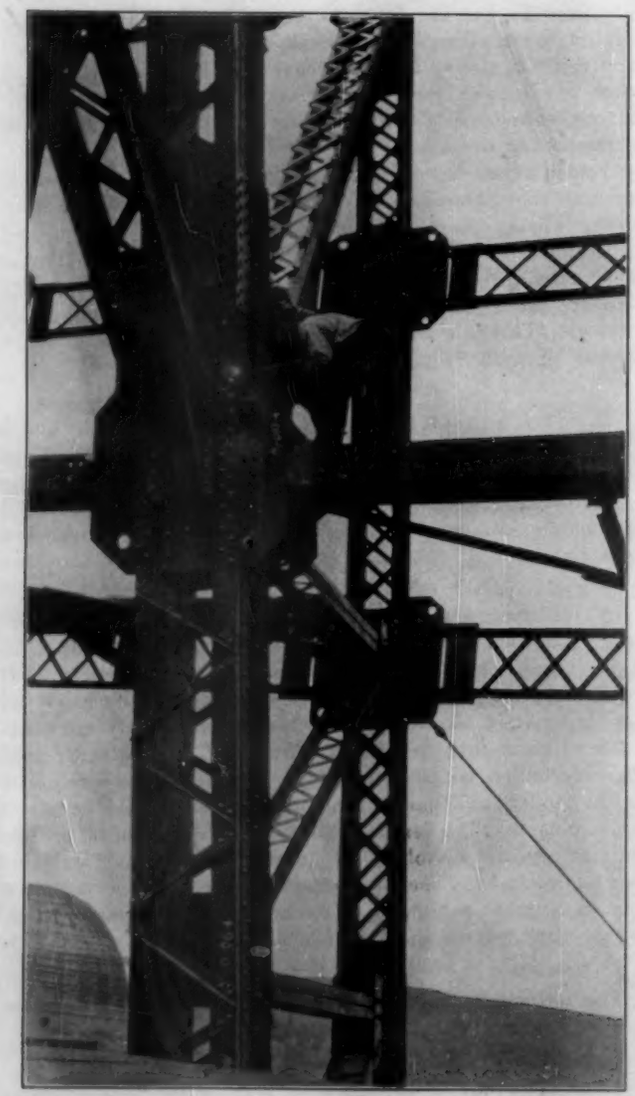
It is not necessary to preheat brass before welding, except to save gas.

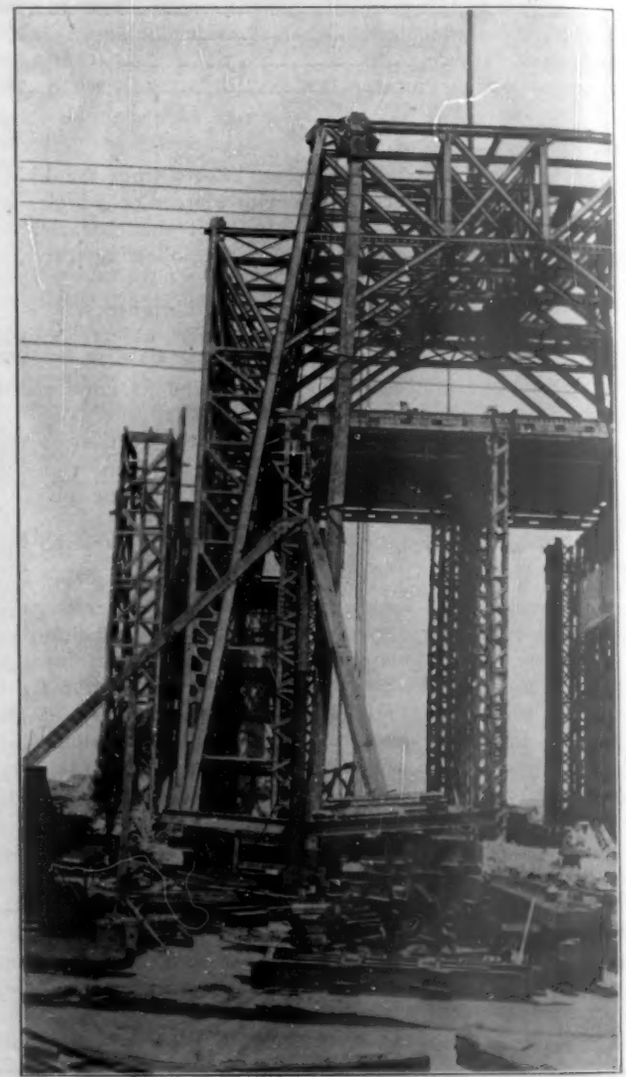
WRECKING "TOWER OF JEWELS."

The accompanying illustrations show the wrecking of the famous "Tower of Jewels" at the Panama-Pacific Exposition.

The original height of the tower was 435 feet, which is but 150 feet high. Above this level bolts and nuts were used in connecting the steel plates and girders to facilitate wrecking, but fully 50 per cent of the nuts were cut loose owing to their being in difficult places. Below the 150 foot level the entire structure is riveted. Cutting operations were commenced on the side structures, cutting through the angles in the valley and through the plates where the box girders are joined. The box girders varied in size from 8 inches square to 3 feet square. The cuts were made so as to leave about 2 inches remaining intact which cut would be made when the steel is being held by the crane ready for lowering. The total weight of the tower is 2,000 tons, while fully 1,500 tons was saved and again utilized for structural steel purposes. In cutting some of the box girders and plates joining them, it was necessary to cut through four to five thicknesses of ½ inch to ¾ inch plates at one time. Sections were lowered of a weight representing the full capacity of the crane. These sections were then compltely separated with a rivet cutting nozzle, the operator being able to remove in the neighborhood of 500 rivets, 1 inch size, in eight hours.

Four Oxweld equipments are being used by the Weissbaum Wrecking Company of San Francisco in the wrecking of this structure.





Famous "Tower of Jewels," Panama Pacific Exposition, Cut Down With Oxy-Acetylene Apparatus.

Steel Car Repairs on Michigan Railway

In the shops of the Michigan Railway at Albion, Mich., of which R. C. Taylor is master mechanic, the oxy-acetylene welding and cutting outfit has become indispensable in connection with steel car repairs, the cutting torch being particularly useful in both construction and repairs to the all-steel car bodies. While the welding torch is used occasionally in this work it has been found more useful in reclaiming and repairing equipment and truck parts. In the oxy-acetylene welding and cutting department there is provided a complete stock of rods of all the different kinds of metal used in equipment parts which may become damaged or broken. While cutting is done by several of the workmen engaged in repairing steel car bodies, welding has been found to require the services of an expert, and accordingly it is done by one man. When the welding outfit was purchased this man received instruction in the various kinds of welding operations, and after about a year's experience he has become very skillful.

Hints for the Welder

When you finish an interesting piece of work, can you set down on paper the manner in which you went about the job, how you prepared the work and how the job was done? Have you learned some little stunt every welder ought to know? Contributions to this department are paid for. Write it down any old way – I'll polish it up. Make a rough pencil sketch and our draughtsman will fix it up fine. Line drawings are more practical than photographs. Do it today – the men on the firing line are waiting. L. B. Mackenzie, Editor.

Editor: Having read with interest the article on welding a bevel gear by A. C. Carlisle in the August issue of The Welding Engineer, I would say; apparently Mr. Carlisle is using a very incorrect method for this class of repair.

Mr. Carlisle states that the gear was heated at spokes 2 and 3 to a cherry red, and that the hub was preheated also; with no mention of preheating any part of the rim.

In the first place, there is absolutely no need of heating the hub in this instance. By doing so, as it expands, it exerts a tremendous pressure against the spokes.

As the rim is not expanded the spokes are not able to take care of the hub expansion, resulting in strains in the spokes and rim and more likely a fracture.

The section of rim above the second spoke not being preheated, will retain tremendous strains upon cooling. Upon heating third spoke, if spoke and section of rim to the left of crack is not preheated, the unequal expansion will result in the decided alteration of dimensions causing more trouble.

It appears to the writer that the teeth between the welds would be so far out of alignment as to require recutting the teeth on practically ⅛ of the gear, making the cost of welding prohibitive.

Some operators insist on believing that a casting must be preheated to a cherry red to get the proper expansion.

This fallacy may be proved by taking any casting and preheating it with the welding torch in the proper place until it is too hot to lay the hand on, or about 600 deg. F. resulting in opening the crack about ⅛ of an inch which is sufficient for the general class of repair work. If this point is reached, and held until the welding operation is completed; there need be no fear of rewelding.

Of course on some work where it is practical to preheat the entire piece, the cherry red idea is good, although not necessary to secure proper expansion. This is more to allow even contraction. Therefore in welding the rim on a large gear that is not preheated all over, care should be taken to gradually diminish heat away from weld to allow shrinkage to normal position without restriction.

On a gear of this description, heating No. 3 spoke to a cherry red means expansion enough to lengthen the spoke ⅛ of an inch due to the temperature being 1,500 deg. F. which is excessive. If welded in this condition and allowed to cool, it will be found that the welded section is approximately ⅛ of an inch too high owing to excessive opening being filled with new metal. As shrinkage takes place, the new metal resists this action with the above result.

When it is impossible to keep from reaching this temperature, means should be provided to bring adjacent sections to the same temperature or as near as possible.

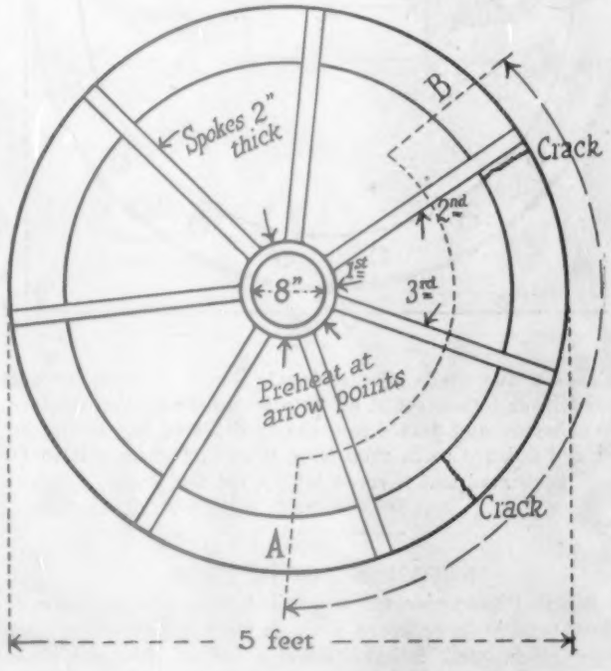
The method used at our shops which has been very successful would be to heat rim from A to B and spokes No. 2, 3, 4 back to line to about 600° F., giving us an expansion of about ⅛ inch. Upon shrinking, it would resume its original dimensions.

On a gear of this diameter a charcoal fire is most suitable, as it can be made to cover a larger surface, with a slower uniform heat than blowtorches. If two men are not available to work fractures simultaneously, care must be taken to keep first weld expanded while welding the second one.

After welds are finished, the heated sections are covered with asbestos paper scrap to ensure slow cooling.

A gear or flywheel should never be covered completely after welding, as heavy parts must be cooled faster than the light ones.

In either of the above cases, the hub should be made to cool first, being the heaviest.



Where it is necessary to weld the hub, if it is not thought advisable to leave it uncovered, means must be provided to keep rim and spokes expanded until the danger point is passed, thereby eliminating all unnecessary strains.

In speaking of making final contraction even, the reader should not assume that there will be absolutely no strains left, as that would be practically an impossibility. All castings of different shapes and thicknesses retain some strains after being moulded.

But the idea is to minimize these strains to the point where owing to their insignificance they are not harmful.

The operator cannot pat himself on the back because the job did not crack upon cooling, unless he has provided the proper expansion that will not only make the job hold, but be free from those troublesome strains that often bring an apparently sound weld back to be rewelded.

The difference of opinion as to correct methods is submit-

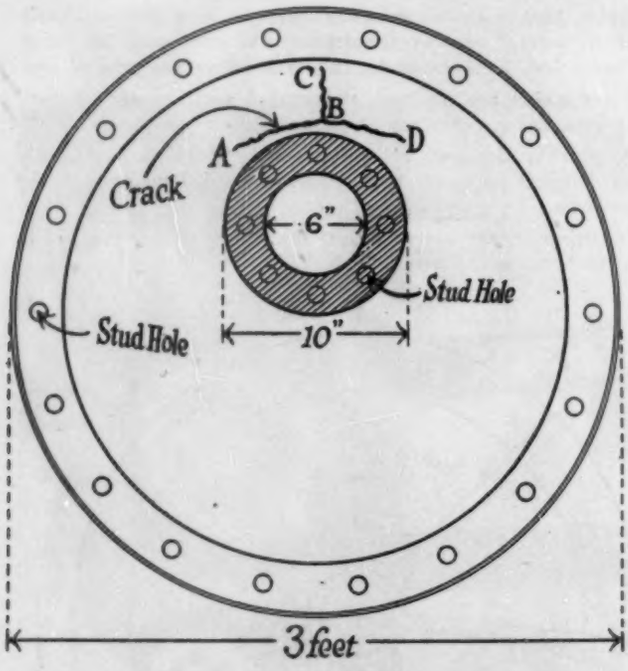
ted only with the desire to place repairs of this nature by the oxy-acetylene torch on a higher efficiency basis.

J. B. Diehl, Superintendent,
Cave Welding & Mfg. Co., Bridgeport, Conn., Shop.

WELDING A CYLINDER HEAD.

Editor:

Illustration shows a crude-oil cylinder head, weighing 150 pounds, being three feet across the base. The rim is two inches thick and three inches wide. The head was cracked, and from A to B the distance was six inches, from C to B three inches, and from B to D five inches. The head was



made of a fine grade of cast iron. I built a brick furnace around it, and then set it up in a welding position, covered with asbestos, and heated to a cherry red. Weld was started at A and finished to B, then from B to C, and from B to D. I then preheated and covered job up for five hours.

A. C. Carlisle

REPAIRING GEAR COGS.

Editor: Please give me a detailed description of how to replace cogs in large gears, such as are used on steam traction engines, etc. I have quite a bit of this work and would like to know the best and quickest way of doing the work. I have trouble keeping my new cogs the right size and shape and so have to do considerable filing and grinding, which makes the work quite expensive and slow.—C. F. W.

Answer: Refer to the July issue of *The Welding Engineer*, page 22. Fig. 4 on page 23 shows a large cast iron wheel, similar to the one our correspondent mentions. In building up the cog a small brick furnace was built around the rim and heated with charcoal for about an hour. The tooth was then built up on the rim and trimmed (or washed) off with the blowpipe to the size required. (With this method it is not necessary to file or grind.) The same results can also be accomplished by fitting carbon blocks on the sides, to the required size of the tooth, after which the rim should be preheated. All of the trimmings should be melted off with the blowpipe, instead of filing or grinding. To finish a tooth should not require more than one hour.—Editor.

AN EXPANSION PROBLEM.

Editor:—Two readers ask you to settle the following argument: B claims that a bar, heated and allowed to cool naturally, contracts more than it has expanded and is shorter than at first. A says he is wrong.

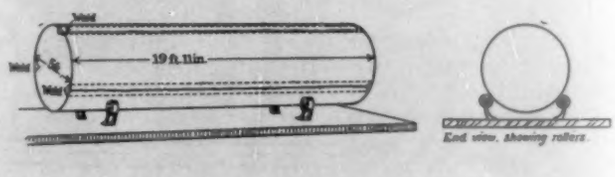
The argument arose over the following work: A runs a "spot" or electric welder and welded for B several ¼" x 1" bars, about 6½ ft. or 7 ft. in length, onto 16 gauge uprights. On cooling the uprights were bent, curving to the bar side. B said this was because on contracting the bar was shorter than before, therefore causing the bend. A claimed it was because in applying the same heat to both thick and thin pieces at the same time, the thinner plate expanded faster than the bar, therefore forcing the bar around. The bar could not straighten again, nor could the plate, because it was welded at intervals of about 6 in. The only way to straighten would be to stretch the bar until it forces the plate back to straight again. Both A and B claim they are right. Which is correct? G. A. S. K.

Answer: When a bar of iron or steel is heated and allowed to cool naturally, the contraction is greater than the expansion, the bar being shorter. In heating iron or steel it must be constantly remembered that the work is larger at the time it is manipulated than it will be when cool. Allowances must therefore be made for shrinkage. Under the same principle as the pattern-maker allows for the contraction of the molten metal to the cold casting, so the welder must allow for contraction of hot iron or steel. The heat temperature of welding iron is 1700° F, to which temperature the bars in question were subjected. When the bars were cold the temperature was from 60° to 70° F. between the working and finished temperature. The expansion of iron may be taken to average about .00000648 of its length for each increase of one degree F. in temperature. Therefore, the difference between the length of the seven foot bar of iron at 60° and 1640° was .0102 of its length when cold. Broadly speaking this means that the seven foot bar has shortened on cooling slightly more than 1/8 of an inch. In welding to 16 gauge uprights with a spot welder the bar shortened on cooling, thus buckling the welded upright about 1/8 inch.—Editor.

WELDING A LARGE DRUM.

Editor:

The accompanying illustration shows a tube mill (or rattler) welded by the writer recently. This drum was made from three sections of 5/16-inch sheet iron. The sheets were first beveled on one side, afterward being formed up in a press. The drum was 19 feet 11 inches long. We first rigged up two rollers to set the job on, as shown, so that

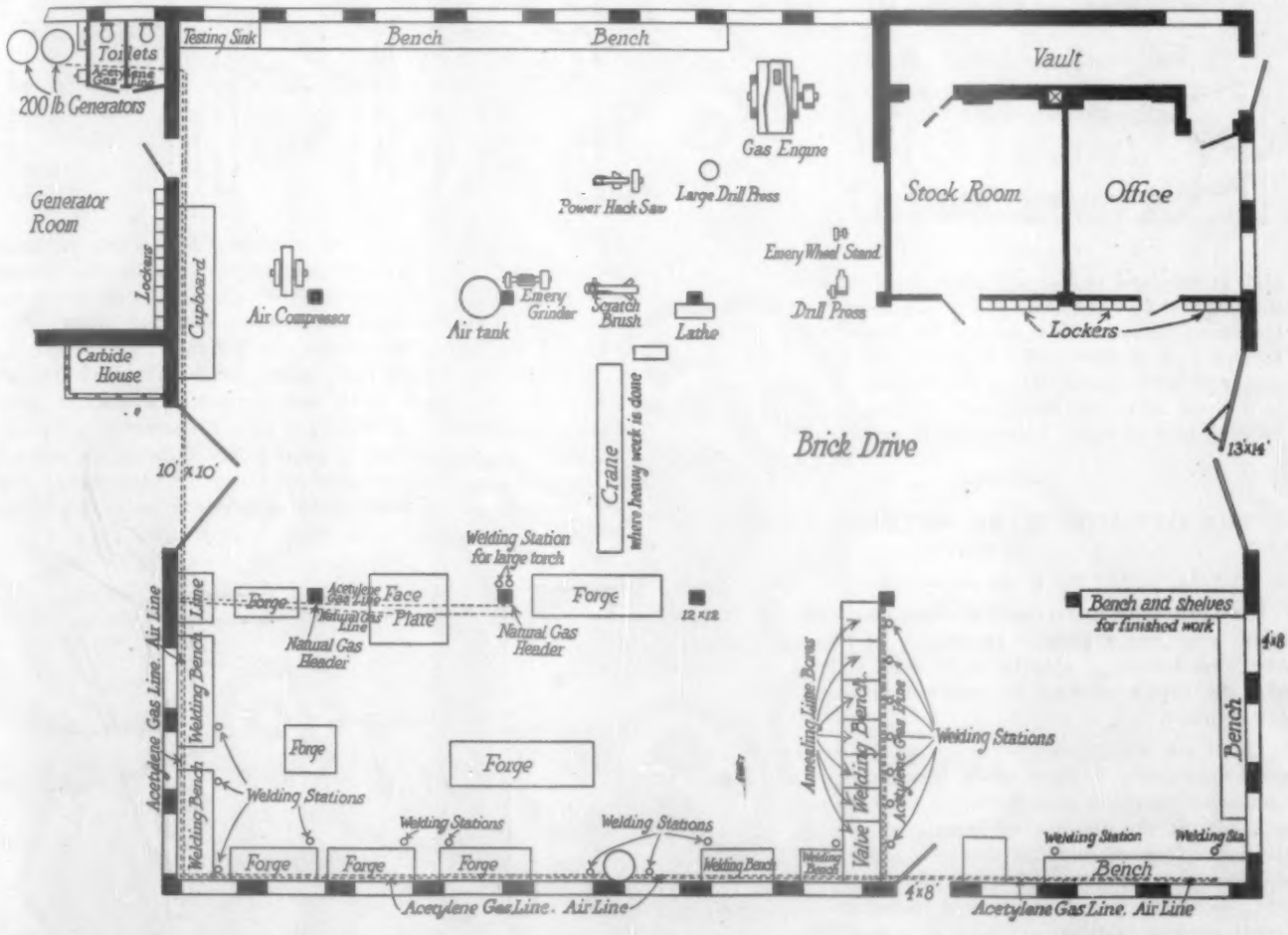


the drum could be turned around readily. Straps were then made and shaped to fit the shell, being placed about a foot and a half apart, inside and outside. On each end of the drum there was a cast iron ring. We put the ring in place on one end and started the weld. The edges of the three seams at the other end being left open about six inches. W had a "flatter" made, about two inches square, and used it in a chipping gun to finish up the seams. We would weld four or five inches and then use the flatter, using a heavy bar with a plate on top of it on the inside, to avoid punching in the weld. As the weld progressed we changed the straps and if the sheets were not pulling together

enough we would put in a smaller bolt in straps, loosening up on other bolts. The job was started on the cast iron ring and welded to the other end, when we turned the shell. The job had to be smooth on the inside, so on finishing we chipped it off and ground the seams with an electric grinder. When the job was finished we knocked off the cast iron rings and welded balance of seams, there being about eight inches of welding to be done on each seam.—Luther McLain.

A MODEL WELDING PLANT.

In this issue we publish a diagram of the plant of the Metals Welding Company, of Cleveland, which will be of interest to the trade. This shop is thoroughly equipped to handle any welding problem which may present itself. Large jobs, up to eight or ten tons, are handled by the crane, and are welded on the brick pavement under the crane, so that



they may be moved readily while hot. All jobs first go to the brick men, who prepare them for welding, by chipping or grinding, beveling, etc. Heavy pieces are first preheated by natural gas or charcoal. This effects a great saving in oxygen and acetylene gas, and makes a stronger and softer weld, and also removes all strains, etc. After castings are welded they are returned to the bench men, who dress up the work. Sheet metal work and lighter castings are welded on the forges and welding benches. In welding aluminum cases the usual method employed is to pack the case with plaster of paris, and when hard, make a weld over the plaster mold. This prevents the aluminum from running through, and enables the welder to make a perfectly homogenous weld, without danger of having the metal run away. Crank shafts and all high grade steels are welded with a 3 per cent nickel steel welding rod. This rod makes a stronger weld, and one that can be hardened. Mr. E. C. Reader is general manager of the company and Mr. H. H. Snyder is superintendent.

INDUSTRIAL WORK FOR JOB SHOPS.

Editor: We have read your last issue with much interest and particularly noted your editorial stating that the future of the business was in the construction and industrial fields. We own a company named the ——— Welding & Cutting Co., and although the returns from repair work have been most gratifying, yet we are aiming for the industrial applications of oxy-acetylene. Should you have in mind any particular branch of manufacturing which offers a good opening along these lines, or know of firms in which it constitutes a vital part of the manufacturing, we would appreciate your advice.—C——— Engineering Co.

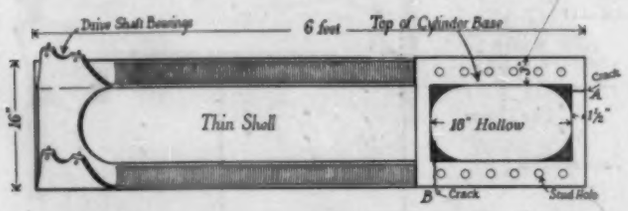
Answer: When we stop to realize the vast number of welding equipments being sold, for use in the manufacturing processes, we begin to have some appreciation of the adaptability of the art of welding. There are, of course, a great many standard articles being manufactured, in connection with which the welder ought to play an important part. We look upon the welder, or the welding engineer if you please, as another type of efficiency engineer. Show him the finished article, tell him the method of manufacture, and he will tell you if he can both improve the work and decrease the cost. Any first class welder can "prowl" around among the plants of any manufacturing district and, if his advice is heeded, cause a lot of welders to thrive where none thrived before. It would be difficult to suggest some particular article to be manufactured for the open market. We imagine local conditions, location and other factors would govern. We do know, however, of one big railroad now manufacturing, from sheet iron, oil torches, oil cans, containers, etc., for various purposes. It is much cheaper to manufacture them than it is to buy them. This road also manufactures hand trucks (from welded tubes),

sheet iron oil cups (to replace brass cups used on locomotives) and many other articles. Chemical manufacturers are trying welded chemical containers to replace glass bottles and oil companies are using metal instead of wood barrels. We learn that step-ladders, for instance, are being made of tubing. It's worth the welder's time to walk through the plant of any big metal working establishment with a view to finding employment for welding apparatus. —Editor.

WELDING A STEAM ENGINE BASE.

Editor:

Illustration shows a steam engine base cracked at the cylinder base, more than half being broken off, as shown by A and B. The base is 1½ inches wide and 8 inches high at A. At B it is 3 inches wide and 8 inches high. The piece broken out weighed 100 pounds, the entire base weighing 1,100 pounds, measuring 6 feet long, 16 inches wide, 8 inches



high at base and 14 inches high at drive shaft base. I scarfed the job first and then clamped it in position. If a job of this kind must be stuck tight so that the strain will not break the second side of the weld. It should be tacked hard in the center of both cracks before preheating. It is not necessary to preheat all of the lower half. I just heat about 8 inches on back side of crack, before and after welding.

A. C. Carlisle.

THE OXY-ACTEYLENE WELDING ON SHEET METAL.

By B. Kopferschmidt.

It is generally understood a sheet metal worker is a tinsmith who has a greater knowledge of the trade than the one who merely is able to make such articles of sheet tin of light gauge as may be required in the services of his employment.

There are many good practical sheet metal workers who are handicapped in their trade because they are unable to compete with those manufacturers who are simplifying their methods in the joining of metals by welding, instead of riveting. Notwithstanding the introduction of labor saving machinery in this line of work, the oxy-acetylene process, when properly introduced, would overshadow all those different devices in labor saving. Moreover, it is this line of work that offers the greatest field for the use of the welding torch. Its use up to this time has extended mostly in the line of repair work, and when one would stop to consider the benefit attained therefrom, what would the result be when its use would be applied to manufacturing work? The answer to this, I think, lies in the near future.

While some of the sheet metal workers do acquire the everyday practice in the art of welding, yet they lack the technical knowledge necessary to enable them to become proficient as experts in this line of work. In this article special attention is given to the fundamental principles that underlie the art and science of oxy-acetylene welding on sheet metal.

The principal features that are necessary for the carrying out of the process in sheet metal welding with satisfactory results are the following:

1. The blowpipe should be of proper size for the work to be performed.
2. The blowpipe should be properly designed so it will get the proper mixture of the gases to be burned.
3. The gases to be used should be supplied to the blowpipe in sufficient quantities to insure a normal flame.
4. A light weight blowpipe.
5. A solid and reliable oxygen pressure regulator that will avoid any variation of pressure in the gas supplied to the blowpipe.
6. A good welder.

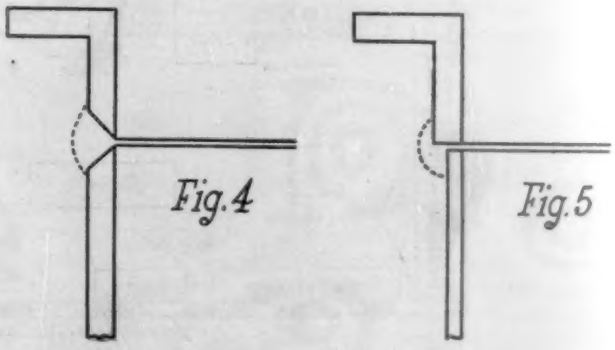
The first five items can be secured by buying them and in dealing with reliable firms one may expect good results.

The last item, however, is the most important factor to be considered. A good welder should know how to select the size of the blowpipe, how to regulate it, how to weld without burning, oxidizing or sticking, and should also

know the different ways of preparing the welds so as to prevent separation, overlapping or buckling of the sheets, and lastly, the most important of all, he should know the effects of expansion and contraction, and the proper remedies to be used to overcome any difficulty.

The welding of very light gauge (under $\frac{1}{32}$ inch) requires a certain amount of skill, and beginners require a great deal of practice before they are able to perform it well.

This class of welding is particularly difficult on account of the separation or warping produced by expansion. Also the least excess of heat tends to produce holes which are difficult to avoid when the sheet is very thin.



If one wishes to weld two sheets, with the edges being placed parallel, he will notice after welding a few inches, that the extreme ends are separating, and upon continuing the work, close in together, and finally start to overlap. In order to overcome this final overlapping two methods are available. One method would be to tack the line of welding every four or five inches before starting to weld. This method, however, presents one difficulty and that is, the bending of the sheet, forming buckles in the line of welding. It will therefore necessitate hammering after the welding is completed.

The other method is to place the two edges to be welded in a V shaped position, the distance of separation at the farthest end to be between 3 per cent and 8 per cent of the length of the welding line. This variation also depends on the thickness of the metal to be welded.

Quality = *Guaranteed* = Quantity

Write US About Your Acetylene Supply

Commercial Acetylene Welding Co.

ATLANTA, GA.
AURORA, ILL.
BOSTON, MASS.
BOUND BROOK, N. J

80 Broadway, New York City

PEOPLES GAS BUILDING
CHICAGO, ILLINOIS

EAST DEERFIELD, MASS.
TORONTO, ONT.
SAN FRANCISCO, CALIF.
MOBERLY, MO.
W. BERKELEY, CALIF.

The best method for a beginner is to apply the above in repetition work to different gauges, and after a few trials the welder knows exactly what separation to give in order to bring the two edges together at the end of the operation. This method would be preferred, as it will be found very adaptable to sheet metal work.

In the welding of thin sheets up to $\frac{1}{16}$ inch or No. 14 gauge, a strong and uniform weld can be obtained if the operator would bend up the edges of both sheets to about $\frac{1}{16}$-inch, and then melt these together. With this method the weld becomes much easier and the metal bent up, serves as a welding rod. If one should desire to equalize the line of welding with the sheet, it will be necessary to hammer the weld after it is finished.

The proper speed of working for welds on sheet metal up to $\frac{1}{16}$ inch is 15 to 20 feet per hour.

Some difficulty is sometimes experienced in bending up

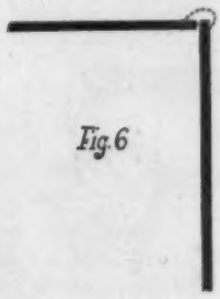


Fig. 6

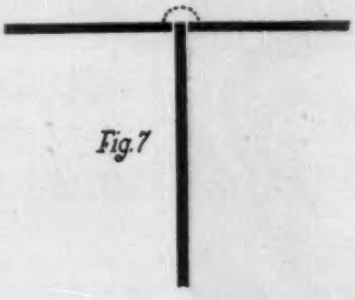


Fig. 7

the edges of sheet metal ranging from $\frac{1}{16}$ inch to $\frac{1}{8}$ inch. In such cases the welder may weld them flat if he will use a pure Swedish iron welding rod or wire, the thickness to be the same as the sheet to be welded. The speed in this case would vary between 12 to 14 feet per hour.

In the welding of sheet metal above $\frac{1}{8}$ inch it is necessary to bevel the edges to a 45 degree angle. The welding rod should be $\frac{1}{8}$ inch for sheet metal of $\frac{1}{8}$ inch to $\frac{3}{16}$ inch and $\frac{3}{16}$ inch for metal of $\frac{1}{4}$ inch to $\frac{3}{8}$ inch.

The average speed of working with $\frac{1}{8}$-inch sheet metal would be 10 feet per hour; for $\frac{3}{16}$-inch sheet metal 9 feet per hour, and for $\frac{1}{4}$-inch, 7 feet per hour.

Before commencing to weld it is necessary to adjust and arrange the edges to be held with clamps or parallels, so that

Fig. 8

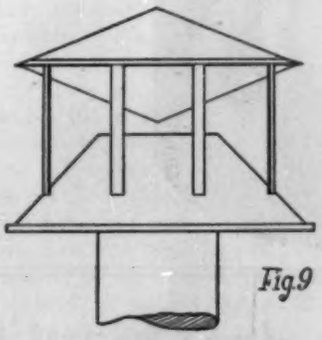


Fig. 9

during the welding operation they will remain intact. This preliminary adjustment is not to prevent the effects of expansion or contraction, but to maintain both edges to the same level.

If some painted or corroded sheet metal is to be welded it becomes necessary to clean thoroughly the edges and their adjacent parts. The cleaning operation can be accomplished with a file, scraper or some chemical action.

In cases where the metals to be joined are of different thickness, such as a plate of $\frac{1}{16}$ inch to one of $\frac{1}{4}$ inch, the welding head chosen should conform with the heavier plate. The blow-pipe used in such a case should be held as near as possible to the heavier plate, whereas sufficient heat should be allowed to reach the lighter plate, so that both edges shall fuse at the same time.

Also another method would be to place a piece of sheet copper directly under the light plate, so that when the heat is applied, the copper would tend to absorb the surplus heat.

Joining by overlapping of the plates or previously grooved should never be attempted in acetylene welding, on account of the interposition of oxide between the metallic parts.

The preparation of welds on bottoms of cylinders and other vessels depends upon the particular strain in each case. If, for instance, the vessels are to contain gases or liquids under pressure the line of welding should be so arranged that the strain is one of tension and not of bending.

Figs. 1 and 2 show the best methods for such purposes.

When the vessel does not have to support a great strain the bottom may be prepared as in Fig. 3.

To weld angle iron rings to cylinders when the thicknesses are the same, both edges are to be beveled, Fig. 4.

To weld thin plates to thick angle iron the preparation of the weld is as in Fig. 5.

In the welding of cylindrical bodies separation is obtained by means of a wedge of appropriate size placed about two-

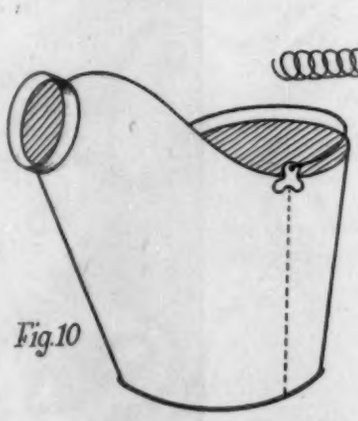


Fig. 10

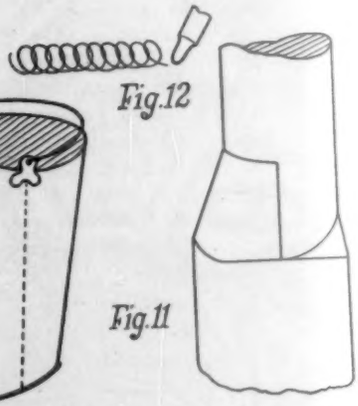


Fig. 12

Fig. 11

thirds along the line of welding. As soon as the weld is commenced the wedge is gradually raised, so that the edges can approach each other as the work proceeds.

For the welding of tanks, the joining should always be made at the angle Fig. 6.

The welding of a partition in a tank should be prepared as in Fig. 7.

To weld one cylindrical body to another it is necessary to prepare it as shown in Fig. 1. Then one may weld a small portion, for example, one inch, then stop and weld about one inch on the opposite side; the same operation should be repeated at six or eight different places. The welding can then be completed without stopping.

Execution of the Welds.

When a shop is equipped with oxy-acetylene welding apparatus it is necessary to devise different mechanical devices for each class of work to increase the efficiency of the welding operation. A welding table, for instance, would be a great help to produce efficient welding.

If the welding is for manufacturing work or of long duration, the operators may do their work sitting; neither the welds nor the speed of welding would suffer.

If, for instance, two pieces of sheet metal of equal thickness are to be welded: the edges are to be beveled if necessary so as to make a thorough weld, and should be so arranged that they will not lie flat on the welding table, but raised, thereby leaving an opening under the welding line.

Just Off the Press! A New Book On

AUTOMOBILE WELDING

With the OXY-ACETYLENE FLAME

By M. KEITH DUNHAM

167 Pages **Price, $1.00** *Fully Illustrated*

This is the only complete book on the "Why" and "How" of Welding

Explains in a simple manner apparatus to be used, its care, and how to construct necessary shop equipment. Proceeds then to the actual welding of all automobile parts, in a manner understandable by everyone.

Gives principles never to be forgotten. Aluminum, cast iron, steel, copper, brass, bronze and malleable iron are fully treated, as well as a clear explaration of the proper manner to burn the carbon out of the combustion head.

Automobile Owners, Garage and Service Stations, Blacksmiths and Machine Shops, as well as industries using the oxy-acetylene flame, will find this book of the utmost value, since the perplexing problems arising when metal is heated to a melting point are fully explained and the proper methods to overcome them shown.

CONTENTS

CHAPTER I.—APPARATUS KNOWLEDGE.

Oxygen Supply—Care of Oxygen Cylinder—Acetylene Generation—Care of Generator—Regulators—Care of Regulator—Creeping Regulators—Gauges—Care of Gauges—Welding Torch—Care of Welding Torch—Effects of Heat—Hose and Goggles.

CHAPTER II.—SHOP EQUIPMENT AND INITIAL PROCEDURE.

Preheating Agencies—Welding Table—Location of Welding Outfit—Starting the Welding Outfit—Adjustment of Flame—Principle of Welding—General Welding Knowledge—Welding Rods and Fluxes—Choice of Tip—Expansion and Contraction.

CHAPTER III.—CAST IRON.

Simple Welding—How to Hold the Flame—Hard Cast Iron—Pin Holes and Blow Holes—Lug on Cylinder—Water Outlet—Cylinder Welding—Compression Head—Finishing and Testing—Scored Cylinders—Cylinder Parts—Fly Wheels—Pistons—Crank Cases—Babbitted Bearings—Valve Guides—Preserving Threads—Conclusion of Cast Iron.

CHAPTER IV.—ALUMINUM.

Use of—Welding Knowledge—Puddle System—Flux System—Comparison of Systems—Welding Rod—Preparation of the Weld—Inlet Manifold—Arm of Crank Case—Welding the Arm Without Taking Out the Motor—Break in the Body of Case—Welding Cold—Wrong Method of Setting Up—Lug or Boss Welding—Preheating the Case—Gas Preheating Flame—One Side or Both—Collapse of Weld—Broken Bearings—Direction of Welding—Shrinkage Cracks—Missing Parts—Finishing—Die Moulded Castings—Body—Other Parts.

CHAPTER V.—STEEL.

Welding Knowledge—What the Flame Does to Steel—The Welding Rod—Simple Welding—Position of Flame—Reinforcing the Weld—Frame Welding—Lengthening the Chassis—Tube Housings—Worn Parts—Gear Welding—Case Hardening—Light Metal Welding—Gasoline Tank—Welding Adjacent to Rivets—Shaft Welding—Construction of Parts.

CHAPTER VI.—MALLEABLE IRON, COPPER, BRASS. BRONZE.

How to Detect Malleable Iron—Brazing Malleable Iron—Rear Housing—Reinforcing the Braze—Brazing Tube to Housing—Building Up Worn Parts—Copper—Brass and Bronze—Silver Soldering.

CHAPTER VII.—CARBON BURNING AND OTHER USES OF OXYGEN AND ACETYLENE.

Principle of Carbon Burning—Method of Operation—Lead Burning—Soldering—Case Hardening—Heating Uses.

CHAPTER VIII.—HOW TO FIGURE COST OF WELDING.

Oxygen Consumption—Dissolved Acetylene Consumption—Torch Consumption Test—Acetylene Generator Consumption—Cost Card—Conclusion.

Sent to any address postpaid on receipt of $1.00

THE WELDING ENGINEER 608 So. Dearborn St. CHICAGO, ILLINOIS

The blow-pipe is then lighted and regulated, and with a steady hand the flame should be directed in a slightly inclined position in a line running with the edges. The best way is to push the blow-pipe rather than pull it, and it should be done slowly and carefully in order to obtain a continuous and regular weld. The best movement to be followed in such a case would be to describe small circles with the white cone, the diameter of which shall be the same as the molten mass obtained. Fig. 12.

If a welding rod is used it must be observed that the melting of the rod and the edges of sheets should be instantaneous, so that the two metals should alloy with each other at the same time.

It usually happens with a beginner that he will either melt too much of the metal and so make holes, or else will not melt enough, so the weld would lack penetration. But after a few trials, of proper practice, he will learn that good welding is nothing more than a regular succession of molten baths; joined one to another so as to form a homogenous line.

The beginning of a weld is always slower than towards the end, because the temperature of the object increases as the work advances, and it is therefore necessary to move the blow-pipe slowly at the beginning and faster at the end.

Also, one should not use an excess of oxygen because of its tendency to oxidize the metal, and so lower the strength of the weld and render it porous and brittle.

The theoretical power of a welding blow-pipe is reckoned according to its hourly consumption of acetylene. The oxygen consumption should be as near to that amount as possible. However, the best designed blow-pipe will always consume between 8 to 10 per cent more oxygen than acetylene.

Following is a table showing the approximate powers to be used with different thicknesses of metal.

Thickness of Metal in Inches	Acetylene, Cu. Ft.-Hr.
1/32	2.5— 3.0
1/16	5.0— 7.0
3/32	8.4—10.2
1/8	11.6—12.5
5/32	12.6—14.5
3/16	15.5—18.0
1/4	18.4—20.0
5/16	21.0—24.0
3/8	28.0—34.0

If a well designed blow-pipe is secured and properly handled, it can last a long time. The only danger in deteriorating a blow-pipe or a welding head is when one tries to clean off the exit nozzle with a steel tool or the tail of a file. The least widening of the nozzle or increasing the exit passage will produce a derangement of the blow-pipe, and the result would be an improper flame. A safe way to clean the blow-pipe is to use a brass wire.

Another important factor in acetylene welding is to have the reducing valves and gauges constantly in good working order. The reducing valves are very delicate instruments and are working like a clock. It therefore becomes very necessary in sheet metal welding, where a half pound pressure makes a big difference, to keep the valves in perfect working condition.

Application.

The applications of oxy-acetylene welding of sheet metal are very numerous and could be extended to the majority of cases where welded sheets or galvanized iron could replace articles of cast bronze, brass, or copper.

In Fig. 8 is shown a view of a five-piece tapering elbow, having a round base and an elliptical top. This form is generally known as a ship ventilator. The seams are welded at the narrow side first, and then at every joint. One-third of the labor is saved by welding over the riveting.

In Fig. 9 is shown a view of an Emerson ventilator with a cone and deflector on the top. If welds should replace the seams and rivets, one-half of the labor would be saved.

In Fig. 10 is shown a view of a funnel strainer pail. One-fourth of the labor is saved by welding instead of seaming or riveting.

In Fig. 11 is shown a view of a hot water boiler. There is a half saving of labor if all the rivet joints should be welded.

Among other articles, manufacturers will find a great saving of labor in welding the following articles: Gasoline tanks, water tanks, large size piping for conveying air blast, hot water boilers, steam separators, welding flanges on light gauge pipes, steam dryers, steel water-tight forms for concrete work, welding of light gauge shells which are afterwards armored and imbedded in cement for water mains of large dimensions, file boxes, bank deposit boxes, air reservoir (for air brake), boxes for storage batteries, switch boxes for electricians, machinery safety guards, side and roof sheets for steel cars, revolving doors and window frames, water coolers, acetylene generators, artistic iron work and ornamental designs, umbrella handles made of two stamped parts, kitchen utensils, oil barrels, acid containers, drums for chemicals, varnish and paint, blast valves, hoops, oil filters and tanks, lawn drums, transformers, ammonia receivers, steam traps, furnaces, steel plate radiators, gas stoves and ovens, garbage incinerators, steel cabinets and furniture, tubes, headlight houses and headlight stands (for locomotives), etc.

HIGH TEMPERATURE FLAMES IN METAL WORKING.

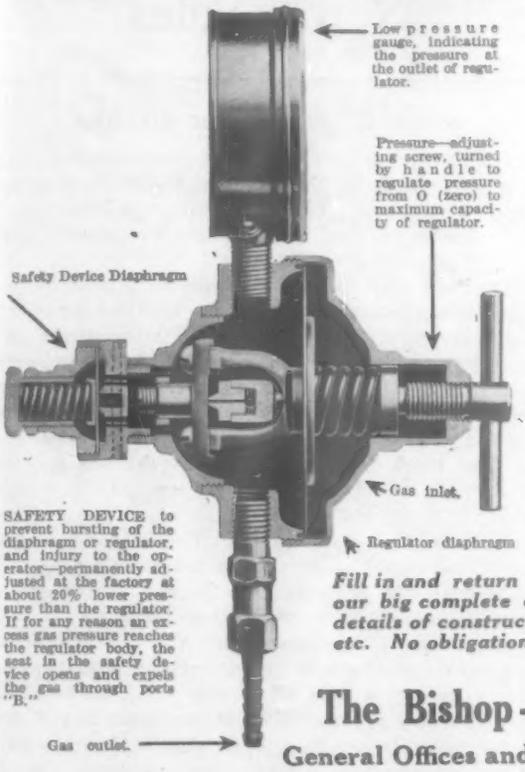
By H. R. Swartley, Jr.

To survey properly the development of metal flame welding and cutting entails a consideration of the gases employed and the facilities provided by the manufacturers of such gases, or the materials from which they are made, to furnish an adequate supply. For "autogenous welding," which is the term applied to fusion of metal under the action of a blow-pipe flame, various forms of fuel gases have been employed, all of them, excepting hydrogen, being some form of gaseous hydrocarbon.

Some of these fuels owe their origin to reclamation of waste or by-products of petroleum industrials. In this class may be included the fuels, which, combined with oxygen, produce the flames known as oxy-acetylene, oxy-benz, oxy-gas, blaugas, etc. The rapidly developing field of autogenous welding, doubtless, is responsible for the efforts of the manufacturers, and those interested in the promotion of these fuels, to develop to the highest economic degree the output of their works. The light of development, therefore, is focused most strongly upon acetylene—that excellent product of the electric furnace. The almost universal preference for this fuel gas, which, used in combination with oxygen, covers almost the entire field of autogenous welding, is based upon well-defined theoretical and working factors.

The two factors governing the degree of flame temperature produced by the combustion of a fuel gas in air or oxygen are the calorific value of the fuel gas and the nature of the products of combustion. If the products of combustion are of low specific heat, the flame produced by burning a fuel gas of high calorific value will produce a flame of high temperature; but if the products of combustion are of high specific heat, the flame temperature is lowered proportionately. A consideration, therefore, of choice of fuels to be employed points to the selection of those containing the highest percentage of carbon with the minimum amount of combined hydrogen, for the reason that the products of combustion of any hydrocarbon are water vapor and carbon dioxide (CO_2). Water vapor, however, has a much higher specific heat than CO_2; hence, the temperature of the flame

Our DIAPHRAGM SAFETY DEVICE


Low pressure gauge, indicating the pressure at the outlet of regulator.
Pressure—adjusting screw, turned by handle to regulate pressure from 0 (zero) to maximum capacity of regulator.
Safety Device Diaphragm
Gas inlet.
Regulator diaphragm
SAFETY DEVICE to prevent bursting of the diaphragm or regulator, and injury to the operator—permanently adjusted at the factory at about 20% lower pressure than the regulator. If for any reason an excess gas pressure reaches the regulator body, the seat in the safety device opens and expels the gas through ports "B."
Gas outlet.

Insures Safety to the Operator —Prevents Accidents

Because of the nature of oxy-acetylene welding and cutting, it is of the utmost importance that the apparatus used be properly designed and made, to insure the safety of the operator. This Special Diaphragm Safety Device makes accidents impossible. You will understand the operation of it by referring to illustration and marginal notes at the left.

We have constantly had in mind the safety of the operator while designing all B-B-B Welding and Cutting Apparatus — regulators, torches and all accessories.

Fill in and return the Coupon for our big complete catalog, showing details of construction, with prices, etc. No obligation to you.

The Bishop-Babcock-Becker Co.

General Offices and Factories, Cleveland, Ohio

Branches in the Larger Cities

The B. B. B. Company, Cleveland, Ohio.

Please mail your complete catalog of Oxy-Acetylene Welding and Cutting Apparatus, with prices, etc.

Name.....

Address.....

W.E.—9-'16

produced by the combustion of a fuel gas of large hydrogen content will be lower than that attained by burning a fuel of higher carbon content with a minimum of hydrogen.

Acetylene (C_2H_2), containing only about 7% of combined hydrogen, has a higher specific heat and greater calorific value than any of the commonly employed fuel gases, and may be considered as the nearest possible approach to gaseous carbon. Other fuel gases may contain not only more combined hydrogen than acetylene, but an additional 5% to 50% of free hydrogen, which, burned to water vapor, will absorb more heat and still further lower the flame temperature.

Combustion of a fuel gas naturally reaches its highest point of efficiency when burned with pure oxygen. Inasmuch as the cost of oxygen is greater, volume for volume, than any of the fuel gases, its consumption naturally is increased for equivalent working performance by absorption of the additional heat units in the combustion of fuel gases of greater hydrogen content. It is, therefore, apparent that acetylene offers the greatest economic possibilities in best meeting the commercial requirements imposed in adapting autogenous welding to specific manufacturing operations.

The working requirements governing the selection of the fuel gas to be employed are ease of production of the gas, safety in its use, ease of application, and high quality of work produced. A prime consideration of autogenous welding, from the standpoint of manufacture, is that it shall produce welds of definite strength, the efficiency of which may be fairly guaranteed. At the inception of the process in Europe these requirements were not well defined, but as the variety of application and scope of the art attained greater proportions, they became better outlined, with the result that the present status of autogenous welding shows practically universal selection of acetylene as the fuel gas which seems best to meet the governing factors. In metal

"Fyber-Weld" Industrial Goggle

The Welder's Delight—Made of fibre—an absolute Non-conductor of Heat. Light and durable.

No. 510. Fitted with Our Famous Essentialite Lenses the exact glass for protecting the delicate organism of sight against Ultra-Violet and Infra Red rays.

Price $3.00 per pair.

No. 510. Fitted with Smoke Green Lenses.
Price $2.00 per pair.

Fyber Spectacle

No. 511. Fitted with Smoke Green Lenses. $1.00 per pair.

No. 511. Fitted with "Essentialite" Lenses. $1.50 per pair.

Manufactured exclusively by

THE CHICAGO EYE SHIELD CO.

Safety Dept. No. 33

2300 Warren Ave. **Chicago, Illinois**

cutting, the factor of the fuel employed becomes of less importance, the oxygen requirement being the principal consideration.

In consequence of the ever increasing carbide demand, that industry has received an impetus far beyond the degree to which it might have been carried by the output necessary for lighting, for which purpose it was originally established. Acetylene may be produced, under practically any condition of climate or temperature, in a generator of simple construction, in which the salient features conform to approved insurance requirements and the regulations governing operation. The development of a successful method of compressing acetylene, whereby large volumes may be transported under pressure in proportionately small bulk, has resulted in the establishment of "compressing stations" with facilities for supplying gas, in portable containers, to practically any part of the civilized world.

Inasmuch as all of the fuels employed require oxygen for their best combustion, a glance at the rate of growth of production of this gas will afford a measurably full indication of the increased application of high-temperature flames in welding and cutting.

The development of autogenous welding and oxygen cutting and the rapidly increasing use of the process in England and Continental Europe resulted in the establishment, in manufacturing centers possessing the largest potential oxygen demand, of generating plants for producing the gas by fractional distillation of air. In Germany and Switzerland the oxygen supply, owing to low cost of hydro-electric power was largely supplemented by the output from industrials dissociating water on a commercial scale. A ready market for the by-product (hydrogen) was found for dirigible balloon, purposes, conversion of vegetable oils and animal fats into edible products, etc. Later, the electrolytic oxygen process, also, was introduced into England.

The introduction of the autogenous-welding and cutting process in this country was attended by great difficulty in obtaining an adequate oxygen supply, although many purchasers of welding and cutting equipment installed apparatus for producing oxygen by chemical means—naturally, at a comparatively high cost. The concerns exploiting the process and embarking in the manufacture of the apparatus for carrying on the work found ready co-operation in the carbide industry, which has consistently increased production to meet the demand. The commercial oxygen supply was that afforded mainly by isolated water-dissociation plants, the hydrogen product of which was utilized in manufacturing purposes, and the oxygen allowed to escape to the atmosphere. Provision was made to store and compress the by-product, oxygen, into portable cylinders. This was the beginning of the commercial oxygen industry in the United States. (1)

With the completion of an air distillation plant on the Great Lakes (2) there was begun the first commercial production of oxygen in this country to meet the demand of the new industry, which, together with the inauguration of a system of distribution by portable cylinders, has increased to such an extent that the cylindrical metal containers for the transportation of oxygen are now familiar objects. The commercial oxygen business has grown by leaps and bounds until the total of the capital invested in the plants and appurtenances, together with the distributing facilities, is large enough to class the industry as a most important one in the list of manufacturing enterprises in this country.

One company (3) claiming, with evident reason, to produce a greater amount of oxygen than any other in the world, has within the past three years established thirty-three oxygen-producing plants and distributing depots. located in manfacturing centers of the United States and has under

Continued on Page 34

News Notes

IMPERIAL ALUMINUM SOLDER.

A new aluminum solder is being brought to the attention of the welding trade by the National Solder Company, 1775 Broadway, New York. The new product is known as "Imperial Aluminum Solder," and is said to possess qualities which will commend it to the trade.

In connection with the use of Imperial Solder the use of a flux is not necessary, as the solder contains its own flux. It is only necessary to clean parts to be soldered thoroughly, using gasoline to remove all dirt and oil, heat from a torch, then being applied as an extra cleanser. The edges of the fracture are then beveled on both sides and the surface of the beveled edges are then cleaned with a wire scratch brush. The torch is then applied to the surfaces to be joined, until the metal becomes hot enough to melt the solder, when it is rubbed on the prepared surfaces. Heat is not applied directly to the solder. The solder flows at 350 degrees F. and may be formed into the work by a soldering iron. The edges to be joined are "tinned," after which the solder, while still fluid, is rubbed thoroughly into the pores of the metal with a scratch brush. A sufficient amount of solder is then melted upon the surfaces to sweat the pieces together. The job is then allowed to set, care being taken that the pieces are not moved while the solder is still fluid.

This operation in practice is so simple that anyone can make a permanent repair in a very few moments. Crank and transmission cases, when repaired, retain their original alinement, and the heat required is, as stated above, only 350 degrees F. The process will not weaken or warp any part to which it is applied, and the tensile strength of lap and butt joints has been shown by actual test to be from 8,540 to 11,780 pounds.

A HARD TEST.

The St. Louis Metal Ware Co., St. Louis, Mo., test the welding work done in their plant from time to time. Recently a sheet of 20 gauge blue-annealed steel, 15 inches wide and 33 inches long was placed in the pulling machine, the sheet being welded in the middle. The sheet broke after showing 3¾ inches elongation and 54,000 pounds tensile strength, the original strength of the material being 56,000 pounds.

HARRIS CALORIFIC CATALOG.

The Harris Calorific Co., Cleveland, Ohio, has published a new catalog describing High Temperature Gas Apparatus. Welding torches, cutting torches, atmospheric burners, adjustable torches, lead burning outfits, gas distributors, preheating torches, crucible furnaces, fluxes, regulators, etc., are described.

Secretary Morrison, of the International Acetylene Association, has issued an announcement of the result of the recent letter ballot to determine the location of the postponed annual meeting of the Association. The annuoncement follows:

It has been decided by the Board of Directors and Officers of the Association after reviewing the vote, to hold the next meeting of the International Acetylene Association for a two day session in New York, on Tuesday and Wednesday, October 24th and 25th. Therefore, be sure and make your plans so as to reserve those dates.

The business of the Association will be very important

and arrangements will be made for two evenings' entertainment, which will equal or excel the very best the Association has ever done before.

Every member of the organization is expected to attend as extremely important matters are to be considered, including the possible revision of all the rules and regulations covering the acetylene industry as now proposed by the National Fire Protection Association, the Interstate Commerce Commission and the United States Government Bureau of Standards in Washington, D. C.

Let us make this deferred meeting of the Association the most enthusiastic and most important that we have ever held.

A. CRESSY MORRISON,
Secretary.

A new catalog has been issued by the Great Western Cutting & Welding Co., San Francisco, Cal., describing Victor apparatus.

B. A. Quayle, who has had charge of the Chicago office of the Standard Welding Co. for many years, becomes general representative, with headquarters at the home office, Cleveland, O.

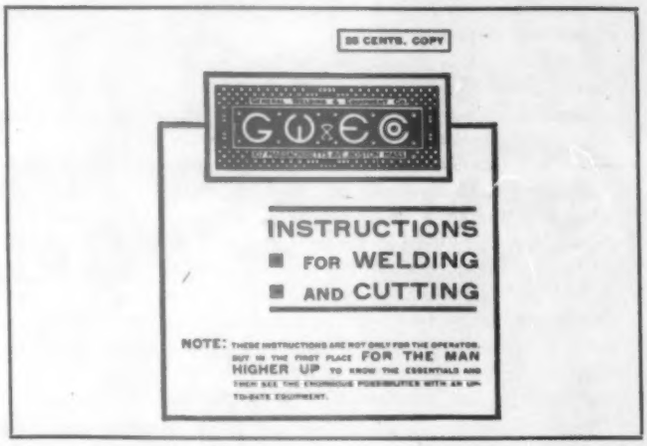
Benton G. L. Dodge, who has had charge of advertising and publicity of the Standard Welding Co. for several years, has taken up the larger duties of manager of sales promotion.

Mr. H. Hartzell, formerly with the Dashiell Motor Company of Chicago, has formed the Hartzell Welding Company and has located his business at Davenport, Iowa. A very attractive and well edited folder carries his message to the business men of the three cities of Davenport, Rock Island and Moline, which are divided only by the Mississippi river. The three cities have a total population of nearly 100,000 and for business purposes can be considered as one.

Position Wanted—As foreman of welding department, railroad or manufacturing plant. All around experience, mostly railroad. Best references. A. W. Y., care *Welding Engineer.*

Position Wanted—Expert welder wants position with garage repair shops in West near mountains. Would take mine job. Best references. W. E. H., care *Welding Engineer.*

Position Wanted—Expert welder, 6 years; 3 years in Studebaker plant. All around auto and car shop experience. Will go anywhere for the right job. Bond, care *Welding Engineer.*


50 CENTS. COPY
G W & E C
INSTRUCTIONS
FOR WELDING
AND CUTTING
NOTE: THESE INSTRUCTIONS ARE NOT ONLY FOR THE OPERATOR, BUT IN THE FIRST PLACE FOR THE MAN HIGHER UP TO KNOW THE ESSENTIALS AND THEN SEE THE ENORMOUS POSSIBILITIES WITH AN UP-TO-DATE EQUIPMENT.

Can You Sell Welding Materials

If you are familiar with the welding business and can sell goods to the welding trade, and can carry a stock of materials worth at least two hundred dollars, we have a good proposition for you.

Write us about your territory. We need more distributors.

WELDING MATERIALS
720—115 South Dearborn Street
CHICAGO

Oxy Acetylene **U.S.** Welding Apparatus
Cutting and Decarbonizing Apparatus
Parts and Supplies
UNITED STATES WELDING CO., Minneapolis, Minn.

Superior Welding and Cutting Equipments
Both Portable and Stationary
Welding and cutting torches, with copper tips.
Special torches made to order, any length.
Sheet metal and aluminum torches.
Oxygen and acetylene regulators, nickel plated.
High and low pressure gauges.
Armored hose and 5-ply hose.
Cast iron welding rods, 24 in. and 36 in. long.
Aluminum rods cast and drawn.
Manganese bronze rods cast.
Tobin bronze rods, drawn, patented.
Fluxes, all kinds, put up in 1-lb. air-tight cans.
Decarbonizers complete.
Imported and American welding wire.
Acetylene generators, automatic motor feed.
Commission men wanted in territory not assigned.
Superior Oxy-Acetylene Machine Co.
Hamilton, Ohio
MICHIGAN: 42 Park St., Kresge Bldg., Detroit, Mich.
NORTHERN OHIO: 1807 Wellman St., Massillion, Ohio

WELDING PHOTOGRAPHS
We make a SPECIALTY of photographing welding jobs
Chicago Architectural Photographing Co.
140 So. Dearborn Street Chicago, Illinois

contemplation additional plants to meet the still rapidly increasing demand.

Advantage has been taken of low power cost in some sections of the country to install electrolytic oxygen-hydrogen producing equipment, in some cases hydro-electric power offering inducements which may render an installation profitable; and the application of autogenous welding to manufacturing has resulted in the installation of electrolytic oxygen-generating equipment by some of the larger industrials. The world curve following may be considered fairly representative of the present volume of oxygen consumed by the welding and cutting industry. The curve is based on percentage of production, with increments for each year, and affords, therefore, a measure of the rate of growth and a means of deducing the importance to which that process has attained in a comparatively short time.

The European development of metal-welding processes may be considered as an extension of soldering or brazing operations, and, as such, generally limited to work on comparatively light sections. It is of interest to note that these limitations were, to a great extent, imposed by the almost universal employment of the low-pressure, or injector, type of oxy-acetylene blow-pipe, acetylene then being available only at slightly above atmospheric pressures. Experiments having shown that better results were obtained with acetylene delivered at the burner tip under independent and appreciable pressure, a type of torch designed to employ both acetylene and oxygen under pressure was brought to the United States in 1907, (1) and a generator providing acetylene under requisite pressure was produced. From that time, the development of the so-called high-pressure welding torch was rapid in this country, resulting in the extension of the new process to a much wider field than had before been possible.

A theoretical consideration of the means whereby the high temperature flame, approximately 6000° F., is produced by the combustion of acetylene in oxygen, shows that 2½ volumes of oxygen are required to burn one volume of acetylene (C_2H_2) completely to its products of combustion, (2) which are carbon dioxide (CO_2) and steam. Acetylene being an endothermic gas, dissociation into its two constituents, carbon and hydrogen, occurs on issue of the mixture from the blow pipe. The supply of oxygen burns the carbon to CO, producing the characteristic white flame at the nozzle. In order to form CO, equal volumes of acetylene and oxygen are required, accompanied by a phase of combustion in which CO burns to CO_2 and the hydrogen later combines with oxygen to form steam.

If it were possible to supply a perfect mixture (equal volumes) of acetylene and oxygen at the nozzle of the blow pipe, the oxygen required to burn CO to CO_2, and the hydrogen to steam, might be abstracted from the air. In practice, however, some of the oxygen required to burn CO to CO_2 must necessarily come from the blow-pipe supply, so that the best torches manufactured today operate successfully with a mixture of 1.1 volume of oxygen to 1 volume of acetylene. The hydrogen evolved, combined with atmospheric oxygen after it has passed from the high temperature zone of the welding flame, surrounds the molten metal and prevents oxidation, at the same time protecting the heated inner cone from loss of heat.

Acetylene supply under low pressure necessitates the employment of a blow-pipe of the true injector type, in which excess oxygen pressure must be supplied in order to deliver the mixture of gases to the nozzle at proper pressures. The limitations of this form of construction afford a less perfect mixture of gases than in the type of welding torch utilizing acetylene and oxygen under independent pressure, and the oxygen consumption is undoubtedly higher than in the latter form of construction. (3) An imperfect mixture of gases results in unsteadiness and instability of the flame, which, together with pre-ignition of the gases while in a mixed condition, due to pre-heating of the blow-pipe nozzle through radiation from the work carried on, produces results less favorable for the continuous operations of manufacture and requirements of steady operation.

The strength of the joint produced by autogenous welding has been a fruitful source of discussion in the application of the process, and many contentions have been advanced as to the necessity of welds of highest tensile strength. It was early found that 100% welds, or, in orther words, those having a breaking strength equivalent to that of the metal itself, could be produced, but the sacrifice of elongation and reduction of area materially lessened the apparent value of such welds. Present practice is directed toward securing a weld of good tensile strength, as compared with the strength of the plate, with high ductility, since, thereby, the service conditions are better fulfilled.(4) The growth in understanding of such requirements has resulted in the production of methods, which, combined with proper apparatus, may uniformly produce these results.

European practice covers the use of the low-pressure acetylene generator and injector type of blow-pipe almost exclusively, the independent-pressure type of torch having shown little development, despite its well known economy of operation. This may reasonably be accounted for by the low prices obtained for the welding and cutting equipment in general use not warranting the expenditures requisite for further development.

The introduction of the process, however, in this country (5) was accompanied by the development of the medium-pressure positive-mixture torch, utilizing both gases under independent pressure, assuring, thereby, stability and quality of the flame, heretofore not produced by the injector form of construction. The applications of the process, in consequence, assumed a radically different aspect than that revealed by the country of its origin, with the result that there has been, and is being, performed most remarkable work in the welding and joining of heavy sections in reclamation and repairing, which, in comparision with the progress attained abroad in similar work, shows advanced practice.

The field in which this country excels that covered by present practice in the countries where the process originated has been developed almost entirely by the pioneer effort and large expenditure of those embarking in an enterprise whose limitations were unknown. Many discouraging failures and costly experiments mark the way to the present undisputable success of the process and its application to modern manufacture.

The early application of the art in this country was generally confined to the establishment of welding repair shops, in which the character of work comprised the reclaiming of broken or defective parts. Manufacturing establishments first adopted the process considered it principally in the light of repair, with only possible applications to the manufacture of their products. It may be said that the quality of work done was in proportion to the degree of knowledge of the limitations of the art then existing. In common with any process capable of elaboration to a similar extent, many attempts were made to perform operations, the successful carrying out of which was beyond the capabilities of the organization and the facilities existing, the results being often to discredit the real value of the process if applied under proper auspices.

A great stimulus to development of oxy-acetylene welding and cutting has been the wide dissemination of knowledge, both theoretical and practical, gained through ceaseless experiment and testing of results produced, by makers of equipment for generating acetylene and oxygen and of welding and cutting apparatus.

What Would It Be Worth To You To Know—

Control Panel

—That your Welding Plant was no longer dependent upon outside supplies for continuous operation?

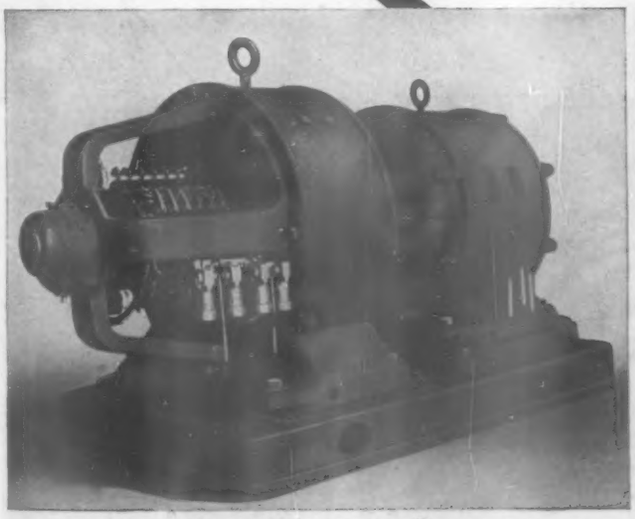
—That when you figured on a job you could do so with the assurance that it would be ready on the date set?

When you install a Westinghouse Arc Welding outfit, you have positive assurance of continuous operation; for the only supply required is electric current—obtained either from the central station, or your own generating plant.

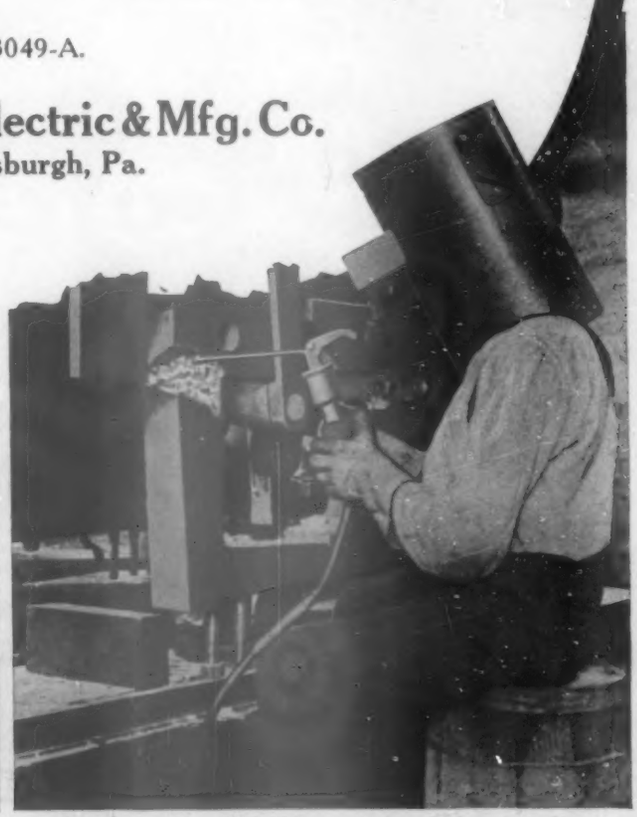
In addition, this equipment will enable you to reduce the cost of welding far below the expense by any other method.

Write for Book 3049-A.

Westinghouse Electric & Mfg. Co.
East Pittsburgh, Pa.



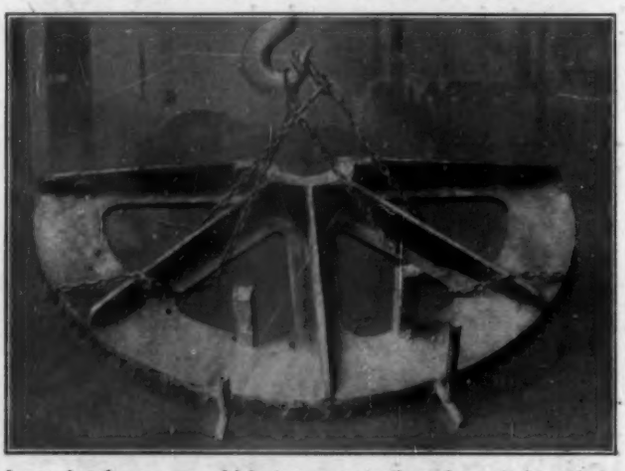
Motor-Generator Set



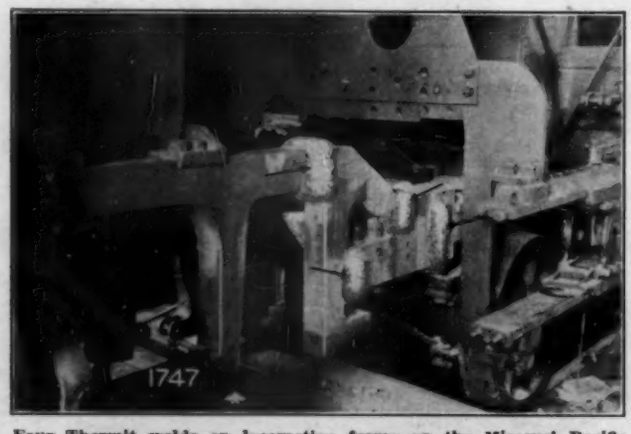
The Welding Operation

Westinghouse

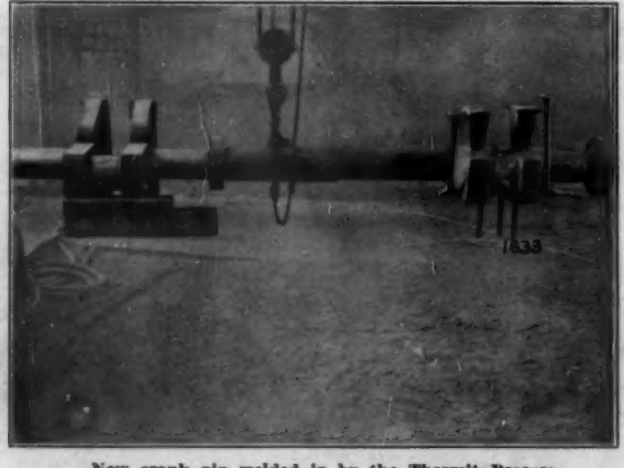
New neck cast on to large roll made with the aid of Thermit and having the pods cast in at the same time.



Large bevel gear on which two new teeth and crack have been repaired.



Four Thermit welds on locomotive frame on the Missouri Pacific Railroad, made without removing the frame from place.



New crank pin welded in by the Thermit Process.

We Are Prepared

To Undertake at a Moment's Notice the Handling of Any Serious Breakdown

Breakage and wear in steel mills and other manufacturing plants has been greater at this time than ever before.

We have been called upon by so many large iron and steel companies recently to make quick repairs to broken rolls and pinions, connecting rods, shears, crank shafts, locomotive frames, and many other sections, the breakage of which often means a serious delay in the operation of the plant, if not a complete shut-down.

Wire or telephone our nearest office and we will proceed at once for arranging the shipment of materials and send an expert to supervise the repair.

We have an eighty-page pamphlet devoted exclusively to this class of work, which is known as pamphlet No. 1779, and tells how the work is executed and how you can do the work yourselves.

Goldschmidt Thermit Co.

William C. Cuntz, General Manager

Equitable Bldg., 120 Broadway
New York

329 Folsom Street, San Francisco — 7300 South Chicago Avenue, Chicago
103 Richmond Street, W., Toronto, Ont.